USER MANUAL

OPC UA Guide

USER MANUAL

Subject to reasonable modifications due to technical advances

USER MANUAL

1 General

The iQunet Server runs an embedded OPC UA (Unified Architecture) Server. OPC UA extends the standard, and highly successful, OPC communication protocol. It enables data acquisition and allows that data to be modelled and communicated between the plant floor and the enterprise reliably and securely. OPC UA is future-ready, easy to configure, and maintain.

2 How to access the OPC UA Server?

2.1 OPC UA Server address

All recorded data can be extracted via the built-in OPC UA Server. The OPC UA Server always listens on port 4840 regardless of how the connection is made (via cable, hotspot, or Wi-Fi).

If you use the hotspot connection, this will be 192.168.42.1:4840.

If you use another connection type, you need to use the IP address of the iQunet Server (xxx.xxx.xx.xx:4840). The Server's IP address is handed out by your DHCP server. The recommended way of operation is to set up your DHCP server to provide a static lease. The current IP address of the Server in the network can easily been found in the "Ethernet-802.3" panel in the iQunet Sensor Dashboard.

It is also possible to set a static IP address in the "Ethernet-802.3" panel. The Server will then start a virtual network interface and will operate from 2 simultaneous IP addresses (the static IP address and the regular DHCP lease). You can then either use the static IP address or the DHCP address for the connection to the OPC UA Server.

2.2 OPC UA Server monitoring

After a power restart of the iQunet system, it will take a few minutes to allow the Server to startup and populate the address space from the database. Thereafter an internal process monitor becomes active which surveys the internal daemons every few seconds. When a problem is detected, a cleanup of the affected processes is performed. This cleanup is reported to the supervisor which can then restart the faulty component. The OPC UA Server is one of the 11 monitored subcomponents.

The supervisor has a local frontend running on port 9001 (http://xxx.xxx.xx.xx:9001 where xxx.xxx.xx.xx is the Server's IP address). The username and password are 'admin'. Please note that only the highest-level master processes are reported here.

2.3 OPC UA variable nodes addressing

There are 3 ways to access variables in OPC:

- via string ID's,
- via numeric node-ID's
- and via browsing.

All 3 options will be explained in more detail below. Which variable nodes are available depends on the type of sensor you are using since the nodes are added dynamically to the address space. Due to the collision of variable names when multiple sensors are present in the OPC UA Server, we only support browsing and numeric node-ID's.

2.3.1 String ID's

The (deprecated) OPC DA way to access variables is through string ID's, where the variable path is encoded into a string with dot separators like for example "ns=2;s=my_sensor.tree.encoded.variablename". We do not support this old style of accessing any more.

2.3.2 Numeric node-ID's

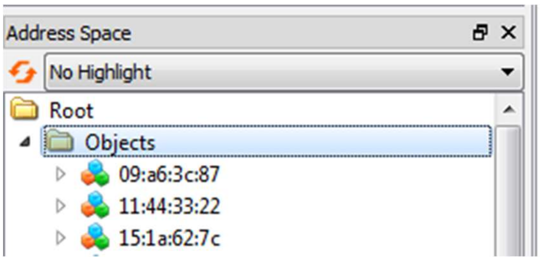
An alternative way is direct access via the UINT32 numeric node identifier like for example "ns=2;i='12345678'". In practice only 31 bits are used to prevent overflow errors in some client software systems. The exact representation depends on your client's software. The client extracts the namespace and 32-bit ID and sends this to the OPC Server.

2.3.3 Browsing

The preferred way of accessing variables is via browsing. iQunet's OPC UA Server supports browsing which means that your client software can browse the address space as follows:

[get node 'root' (ns=0)]
➔ [Objects (ns=0)]
➔ [get sensor children with ns=2]
➔ [get Sensor 'ab:cd:de:ef']
➔ [get Variable 'mmsRmsX']

For example, in UA Expert browsing looks like this:

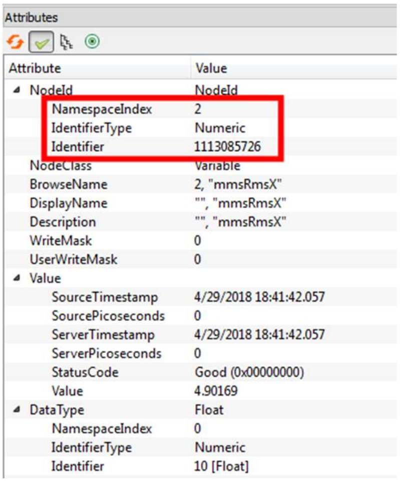


The Server will send back an ua-node struct object containing the numeric node-ID (as described above). Your client can cache and use this numeric node-ID for fast direct access in all future requests in the same session.

In the figure below, you can see that our Server supports node identifiers of the type "Numeric".

The node below can thus be accessed as follows:

- via browsing: Root ➔ Objects ➔ '15:1a:62:7c' ➔ 'mmRmsX'
- or via direct access: "ns=2;i=1113085726".



Attributes

Attribute	Value
NodeId	NodeId
NamespaceIndex	2
IdentifierType	Numeric
Identifier	1113085726
NodeClass	Variable
BrowseName	2, "mmsRmsX"
DisplayName	"", "mmsRmsX"
Description	"", "mmsRmsX"
WriteMask	0
UserWriteMask	0
Value	
SourceTimestamp	4/29/2018 18:41:42.057
SourcePicoseconds	0
ServerTimestamp	4/29/2018 18:41:42.057
ServerPicoseconds	0
StatusCode	Good (0x00000000)
Value	4.90169
DataType	Float
NamespaceIndex	0
IdentifierType	Numeric
Identifier	10 [Float]

The OPC UA standard requires this numeric node-ID to remain static only for 1 single server session. The client software must then re-request the node-ID mapping for each session. Our Server will however remap the same IDs to the same endpoints to support client software with incorrect caching.

3 iQunet OPC UA variable nodes

The OPC UA variable nodes used by iQunet are described below per sensor type. For comparison it is described and shown in figures what these nodes represent on the iQunet Sensor Dashboard.

3.1 General server nodes

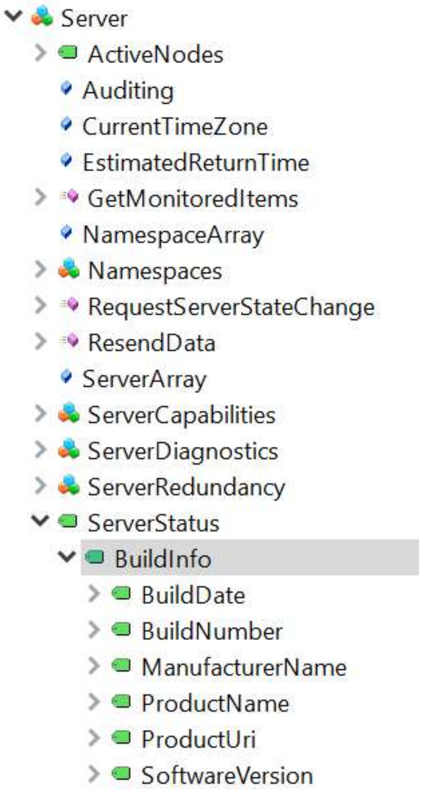
3.1.1 Build information (available from software version 1.9.2)

From software version 1.9.2 on, you can find the build information of your iQunet Server in the "***BuildInfo***" sub node underneath the "***Server***" node.

If you click on the arrow next to the "***Server***" name in UA Expert, the "***ServerStatus***" sub node will appear. Open the "***ServerStatus***" node by clicking on the arrow icon and the "***BuildInfo***" sub node will appear. Open the "***BuildInfo***" node.

For each Server, the following build information can be found:

- "***BuildDate***" node: date of the latest software build currently running on your iQunet Server,
- "***BuildNumber***" node: number of the latest software build currently running on your iQunet Server,
- "***SoftwareVersion***" node: software version currently running on your iQunet Server.



- Server
  - ActiveNodes
  - Auditing
  - CurrentTimeZone
  - EstimatedReturnTime
  - GetMonitoredItems
  - NamespaceArray
  - Namespaces
  - RequestServerStateChange
  - ResendData
  - ServerArray
  - ServerCapabilities
  - ServerDiagnostics
  - ServerRedundancy
  - ServerStatus
    - BuildInfo
      - BuildDate
      - BuildNumber
      - ManufacturerName
      - ProductName
      - ProductUri
      - SoftwareVersion

3.2 General sensor nodes

3.2.1 Battery power level

The “***batteryVoltage***” node gives an indication of the battery power level (“Power” value in the System Information pane).

3.2.2 Wakeup interval

The “***beatperiod***” node represents the wakeup interval of the sensor (“WakeUp Interval” setting in the Network Interface pane).

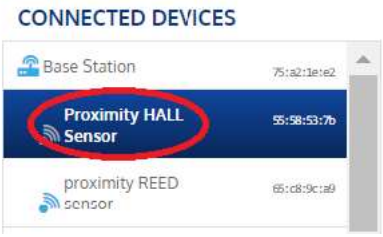
The wakeup interval is an internal parameter of the iQunet sensors and indicates the maximum time interval at which the sensor must exit sleep mode and contact the Base Station to collect its scheduled tasks. If no task has been scheduled for this sensor or if the Base Station could not be contacted (for example because the Base Station is out of range), the sensor will return to sleep mode for the wakeup interval period. The purpose of the wakeup interval is to extend the battery lifetime.

3.2.3 Temperature

The “***boardTemperature***” node contains the temperature value measured with the build in temperature sensors (“Temperature” value in the System Information pane).

3.2.4 Device name tag

The “***deviceTag***” node contains the name given to the sensor in the “Connected Devices” list.



CONNECTED DEVICES

Base Station	75:a2:1e:e2
Proximity HALL Sensor	55:58:53:7b
proximity REED sensor	65:c8:9c:a9

3.2.5 Firmware version

The “***firmware***” node contains the current firmware version of the sensor (“Firmware” version in the System Information pane).

3.2.6 Googlesheets identifier

The “***googlesheets***” node contains an internally used identifier string.

3.2.7 Hardware version

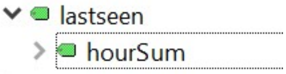
The “***hardware***” node contains the hardware version of the sensor (“Hardware” version in the System Information pane).

3.2.8 Last seen

The “***lastseen***” node represents the last moment in time a sensor was seen live for the iQunet Server in the local sensor network (“Last Seen” value in the Network Interface pane).

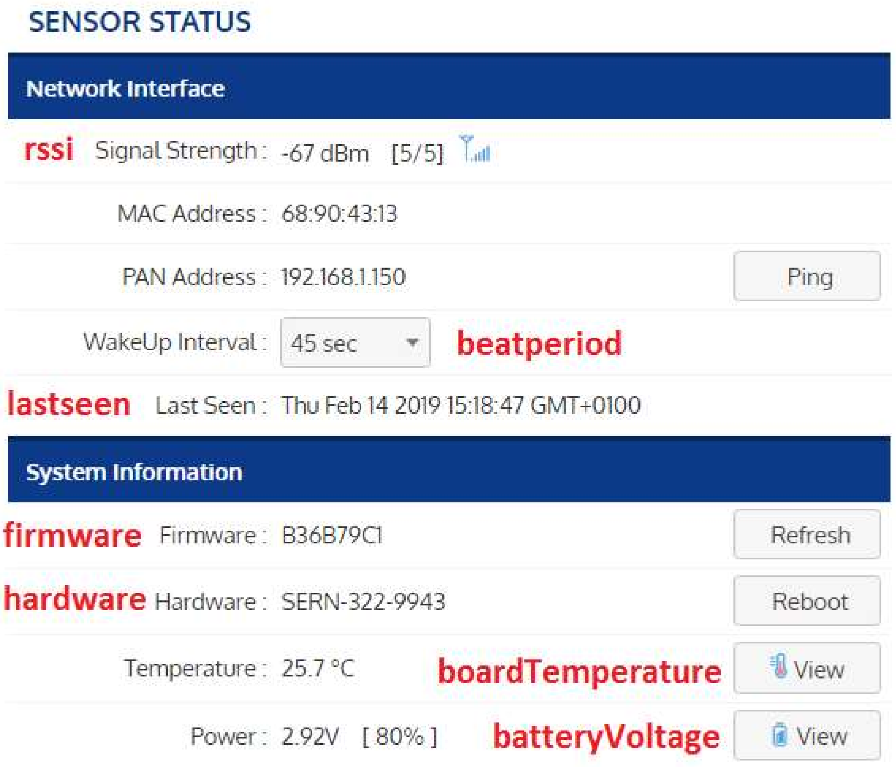
3.2.9 Number of connections per hour (available from software version 1.6.12)

The ***"hourSum"*** node (located underneath the "***lastseen***" node) represents the number of connections to the sensor made per hour or in other words the number of times the sensor has been seen per hour.



3.2.10 Signal strength

The "***rssi***" node represents the current wireless signal strength between the device and the Base Station ("Signal Strength" value in the Network Interface pane).


SENSOR STATUS

Network Interface

rssi Signal Strength : -67 dBm [5/5]

MAC Address : 68:90:43:13

PAN Address : 192.168.1.150

WakeUp Interval : 45 sec beatperiod

lastseen Last Seen : Thu Feb 14 2019 15:18:47 GMT+0100

System Information

firmware Firmware : B36B79C1

hardware Hardware : SERN-322-9943

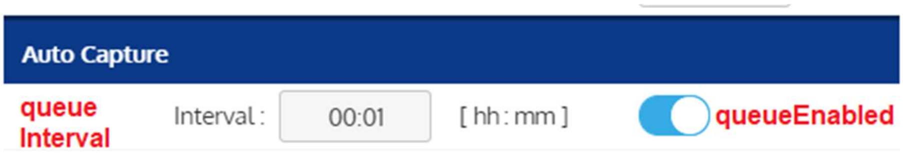
Temperature : 25.7 °C boardTemperature

Power : 2.92V [80%] batteryVoltage

3.2.11 Automatic measurements

The "***queueEnabled***" node shows if automatic measurements are enabled or not (slider in the Auto Measurements, Auto Capture or Capture Interval pane).

The "***queueInterval***" node represents the time between two automatic measurements in seconds ("Queue Interval" value in the Auto Measurements, Auto Capture or Capture Interval pane).


Auto Capture

queue Interval Interval : 00:01 [hh : mm] queueEnabled

3.3 Hall Effect Proximity Sensor nodes

3.3.1 Hall field

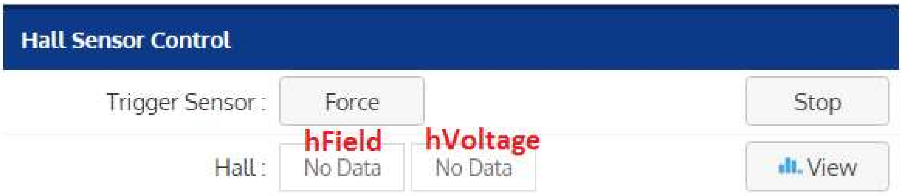
The “***hField***” node contains the measured magnetic field value (first box of the “Hall” values in the Hall Sensor Control pane).

3.3.2 Hall voltage

The ***“hVoltage”*** node represents the measuring voltage used for calibration purposes (second box of the “Hall” values in the Hall Sensor Control pane).

3.3.3 Hall sensitivity

The “***hallSensitivity***” node contains a unitless number between 0 (off) and 255 (highest sensitivity).



3.4 Inclination Sensor nodes

3.4.1 Activity threshold level

The “***activityThreshold***” node represents the required activity level to wake up the sensor (“Activity Level” setting in the Tilt Sensor Control pane).

3.4.2 Burst samples

The “***burstSamples***” node represents the number of samples in 1 burst measurement (“Burst Samples” value in the Tilt Sensor Control pane).

3.4.3 Guard roll

The “***guardRoll***” node contains the maximum roll value allowed before an alarm is initiated (“Guard Roll” setting in the Tilt Sensor Control pane).

3.4.4 Pitch position value

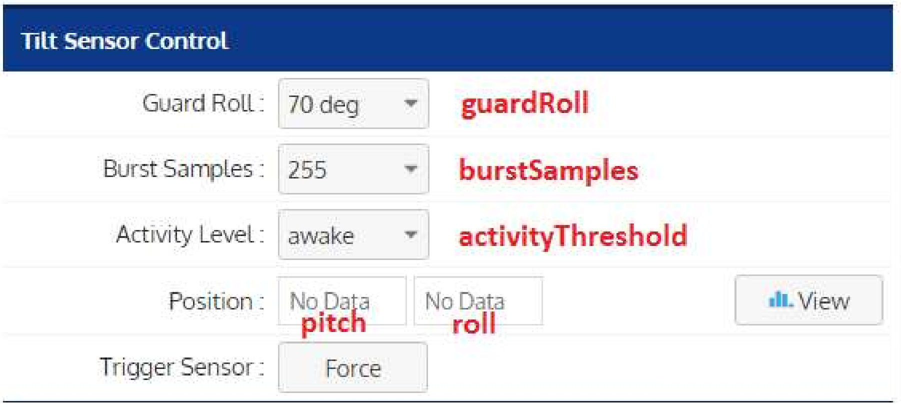
The “***pitch***” node contains the pitch value of the inclination (first box of the “Position” values in the Tilt Sensor Control pane).

3.4.5 Roll position value

The “***roll***” node contains the roll value of the inclination (second box of the “Position” values in the Tilt Sensor Control pane).

3.4.6 Yaw position value

The “***yaw***” node contains the yaw value of the inclination (not used).



Tilt Sensor Control

Guard Roll : 70 deg guardRoll

Burst Samples : 255 burstSamples

Activity Level : awake activityThreshold

Position : No Data pitch No Data roll

Trigger Sensor : Force

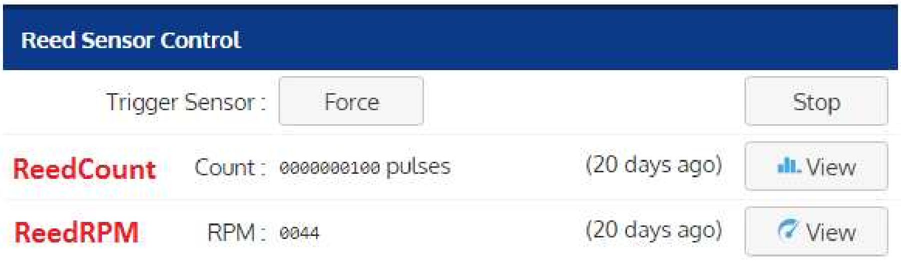
3.5 Proximity Reed Switch Sensor nodes

3.5.1 Reed count value

The “***ReedCount***” node contains the counted number of magnetic pulses (“Count” value in the Reed Sensor Control pane).

3.5.2 Reed RPM value

The “***ReedRPM***” node contains the calculated revolutions per minute value based on the magnetic pulses count (“RPM” value in the Reed Sensor Control pane).



Reed Sensor Control

Trigger Sensor :	Force		Stop
ReedCount	Count : 0000000100 pulses	(20 days ago)	View
ReedRPM	RPM : 0044	(20 days ago)	View

3.6 Vibration Sensor nodes

3.6.1 Acceleration measurement data

The “***accelerationPack***” node contains the last recorded raw vibration data.

The ***accelerationPack*** format is as follows:

1/ numSamples: n = #samples
2/ accelArray: rawSample[0:n-1]
3/ sampleRate: e.g. 400 = 400Hz
4/ formatRange: e.g. 4 = +/-4g (hardware setting of the accelerometer IC)
5/ offset: unused, 0 (hardware offset of the accelerometer IC)
6/ encoded_axis: X = 0, Y = 1, Z = 2
7/ prescaler: unused (only used when no compression in debug mode)
8/ compression: unused (0 = no compression in debug mode, 1 = compression)

You will see that the first 7 samples of the accelArray (at the start of each measurement) show a transient response due to the start-up behavior of the compression algorithm. Since a Hanning window is used for the calculation of the DFT and RMS, this behavior will be automatically suppressed and thus has no further impact.

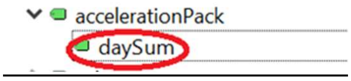
The conversion of the accelArray to g units is as follows:

Conversion of rawSample[0:n-1] to [g]:

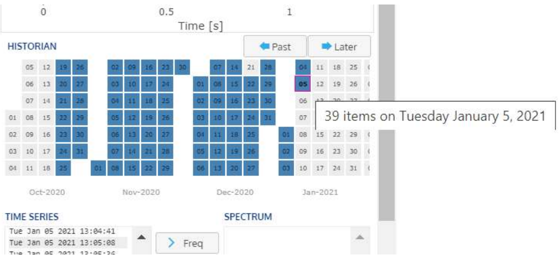
gSample = (rawSample[0:n-1]/512.0) * formatRange [g]
gTimes = [0:n-1]/sampleRate [sec]

3.6.2 Number of downloads per day (available from software version 1.4.15)

The “***daySum***” node contains the number of downloaded measurements per day.



Remark: the daySum value in OPC UA can differ from the number of measurements listed in the calendar on the iQunet Sensor Dashboard since OPC uses UTC time to align the day.



39 items on Tuesday January 5, 2021

Tue Jan 05 2021 13:04:41
Tue Jan 05 2021 13:05:08

Remark: the total number of measurements/captures made per day is shown in section 3.6.16.

Remark: all 3 axes (X, Y and Z) are captured at the same time, but downloads are performed consecutively per axis. So, for each capture, there can be 3 downloaded measurements.

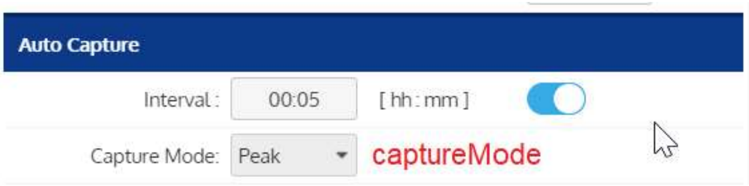
3.6.3 Measurement axis

The “***axis***” node represents the measurement axis (“Axis” setting in the Measurement Setup or Capture Setup pane).

From software version 1.4.17 on, the “***axis***” node has been renamed to “***channel***”.

3.6.4 Capture mode (available from software version 1.5.0)

The “***captureMode***” node represents the selected capture mode (“Capture Mode” setting in the Auto Capture or Capture Interval pane). This attribute is only available for the 24V Powered Vibration Sensor. The capture mode can be set to “peak” (measurement with the highest peak power during the set measurement interval is saved) or “instant” (measurement is taken at the end of the set measurement interval).



Auto Capture

Interval : 00:05 [hh : mm]

Capture Mode: Peak

captureMode

3.6.5 Number of measurements per setting

The “***captureStats***” node displays the number of measurements made per setting when its callback function is called.

3.6.6 Conversion factor

The “***convFactor***” node contains a conversion factor (for most sensors this factor will be 1g/g).

3.6.7 External power level

The “***externalVoltage***” node contains the externally applied voltage level (this attribute is only available for the 24V Powered Vibration Sensor). If the external power cable is connected, this value will be 3.3V (first “Power” value in the System Information pane).

3.6.8 Dynamic range

The “***formatRange***” node represents the dynamic range of the sensor (“Limit”/ “Range” setting in the Measurement Setup or Capture Setup pane).

3.6.9 Statistics values (Kurtosis and RMS)

For software versions up to 1.4.16:

The “***gKurtX***” node contains the last calculated kurtosis value on X axis in g units (see Statistics Lab).

The “***gKurtY***” node contains the last calculated kurtosis value on Y axis in g units (see Statistics Lab).

The “***gKurtZ***” node contains the last calculated kurtosis value on Z axis in g units (see Statistics Lab).

The “***mmsKurtX***” node contains the last calculated kurtosis value on X axis in mm/s units (see Statistics Lab).

The “***mmsKurtY***” node contains the last calculated kurtosis value on Y axis in mm/s units (see Statistics Lab).

The “***mmsKurtZ***” node contains the last calculated kurtosis value on Z axis in mm/s units (see Statistics Lab).

The “***gRmsX***” node contains the last calculated rms value on X axis in g units (see Statistics Lab).

The “***gRmsY***” node contains the last calculated rms value on Y axis in g units (see Statistics Lab).

The “***gRmsZ***” node contains the last calculated rms value on Z axis in g units (see Statistics Lab).

The “***mmsRmsX***” node contains the last calculated rms value on X axis in mm/s units (see Statistics Lab).

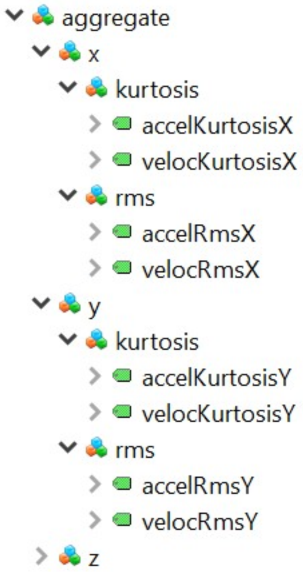
The “***mmsRmsY***” node contains the last calculated rms value on Y axis in mm/s units (see Statistics Lab).

The “***mmsRmsZ***” node contains the last calculated rms value on Z axis in mm/s units (see Statistics Lab).

Remark: it is possible that you also see the above nodes in software versions from 1.4.17 on since OPC UA nodes cannot be deleted. Once these nodes have appeared in OPC UA, they will remain present next to the new “***aggregate***” node.

<u>For software versions from 1.4.17 on:</u>

The “***aggregate***” node contains a custom OPC UA data container structure containing the last calculated RMS and Kurtosis statistics on the X, Y and Z axis. The data structure contains the acceleration (accel) and velocity (veloc) Kurtosis statistics (accelKurtosisX, velocKurtosisX) and RMS statistics (accelRmsX, velocRmsX) for each axis (X, Y and Z).



- aggregate
  - x
    - kurtosis
      - accelKurtosisX
      - velocKurtosisX
    - rms
      - accelRmsX
      - velocRmsX
  - y
    - kurtosis
      - accelKurtosisY
      - velocKurtosisY
    - rms
      - accelRmsY
      - velocRmsY
  - z

3.6.10 Number of samples

The “***numSamples***” node contains the number of measurement samples (“Samples” setting in the Measurement Setup or Capture Setup pane).

3.6.11 Number of prefetch samples (for software versions up to 1.6.2)

The “***prefetch***” node contains the number of prefetch samples (“Prefetch” setting in the Measurement Download pane).

3.6.12 Sampling rate

The “***sampleRate***” node represents the sampling rate of the sensor (“Rate” setting in the Measurement Setup or Capture Setup pane).

3.6.13 Anomaly Detection models

The “***tensorFlow***” node shows the calculated Anomaly Detection models underneath the “***models***” sub node (if there are models available).

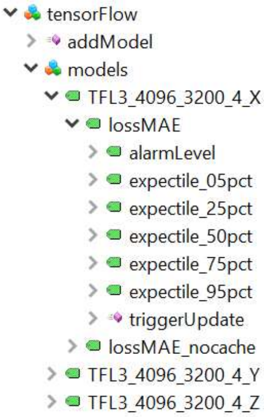
If you click on the arrow next to the “***tensorFlow***” name in UA Expert, the “***models***” sub node will appear. If there are models available for this sensor, you can open the “***models***” node by clicking on the arrow icon. All models created for this sensor will appear. The models will have the same names as in the iQunet Sensor Dashboard.

For each model, the following AI parameters can be extracted:

- “***lossMAE***” node: Raw prediction error (“raw” signal in the figure in the iQunet Sensor Dashboard)
- “***Expectile_05pct***” node: Expectile 5% (“LO 5%” signal in the figure in the iQunet Sensor Dashboard)
- “***Expectile_25pct***” node: Expectile 25%
- “***Expectile_50pct***” node: Expectile 50% (“median” signal in the figure in the iQunet Sensor Dashboard)
- “***Expectile_75pct***” node: Expectile 75%
- “***Expectile_95pct***” node: Expectile 95% (“HI 95%” signal in the figure in the iQunet Sensor Dashboard)
- “***alarmLevel***” node: the alarm level set in the iQunet Sensor Dashboard

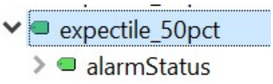
Remark: anomaly data is calculated from the start of the model’s training period. Data older than the timestamp of the start of the training period will not be displayed in the Anomaly Monitor in the iQunet Sensor Dashboard nor in OPC UA.

The “***triggerUpdate***” node contains a callback function which recalculates and updates the AI model plot in the iQunet Sensor Dashboard when called.



- tensorFlow
  - addModel
  - models
    - TFL3_4096_3200_4_X
      - lossMAE
        - alarmLevel
        - expectile_05pct
        - expectile_25pct
        - expectile_50pct
        - expectile_75pct
        - expectile_95pct
        - triggerUpdate
      - lossMAE_nocache
    - TFL3_4096_3200_4_Y
    - TFL3_4096_3200_4_Z

Underneath every expectile, you can also find an “***alarmStatus***” sub node (alarm status is false if the latest value of the expectile is lower than the set alarm level, true if the latest value is above the set alarm level).



- expectile_50pct
  - alarmStatus

3.6.14 Vibration download threshold

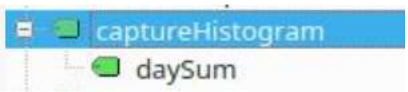
The “***threshold***” node contains the threshold level for full vibration download (“Threshold” setting in the Measurement Download or Download Filter pane).

3.6.15 Capture histogram (available from software version 1.6.3)

The “***captureHistogram***” node contains the calculated peak power histogram used to compare with the threshold level for full vibration download (blue bars in the histogram graph in the Download Filter pane).

3.6.16 Number of measurements (available from software version 1.6.12)

The “***daySum***” node (located underneath the “***captureHistogram***” node) represents the total number of measurements or captures made per day.



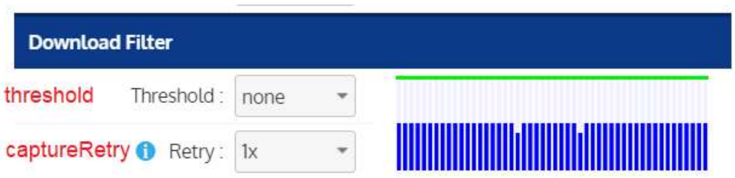
captureHistogram
daySum

Remark: the number of measurements that have actually been downloaded is shown in the “***daySum***” node located underneath the “***accelerationPack***” node (see 3.6.2).

Remark: all 3 axes (X, Y and Z) are captured at the same time, but downloads are performed consecutively per axis. So, for each capture, there can be 3 downloaded measurements.

3.6.17 Capture retries (available from software version 1.6.3)

The “***captureRetry***” node contains the number of capture attempts in each measurement interval if the threshold level is not yet exceeded (“Retry” setting in the Download Filter pane).



Download Filter

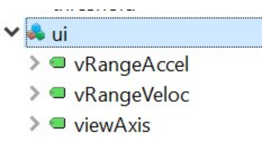
threshold Threshold : none

captureRetry Retry : 1x

3.6.18 View axis (available from software version 1.4.15)

The “***ui***” node contains User Interface settings.
The underlying “***viewAxis***” node shows the view axis selector setting (“viewAxis” setting in the Vibration Lab under the “XYZ” view axis selector tab).

Remark: this setting is only available for software versions 1.4.15 and higher.



ui
vRangeAccel
vRangeVeloc
viewAxis

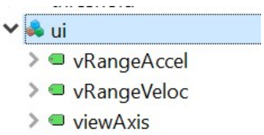
3.6.19 Viewport range

The “***vrange_accel***” node represents the viewport range in g units in the Vibration Lab (“Viewport” setting in the Vibration Lab under the Units tab).

The “***vrange_veloc***” node represents the viewport range in mm/s units in the Vibration Lab (“Viewport” setting in the Vibration Lab under the Units tab).

USER MANUAL

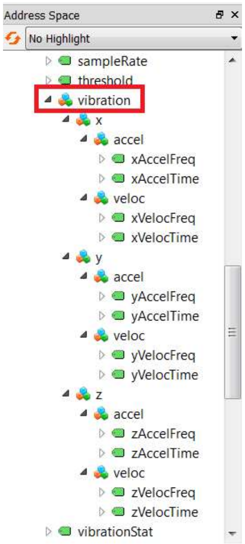
From software version 1.4.17 on, the “***vrange_accel***” node has been renamed to “***vRangeAccel***” and the “***vrange_veloc***” node to “***vRangeVeloc’***. These nodes are now located underneath the “***ui***” node together with the “***viewAxis***” node.



- ui
  - vRangeAccel
  - vRangeVeloc
  - viewAxis

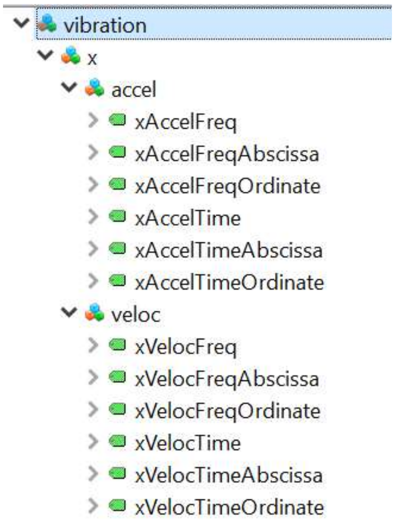
3.6.20 Vibration measurement data

The “***vibration***” node contains a custom OPC UA data container structure containing the last recorded vibration data on the X, Y and Z axis. The data structure contains the acceleration (accel) and velocity (veloc) data in the time (xAccelTime, xVelocTime) and frequency domain (xAccelFreq, xVelocFreq) for each axis (X, Y and Z).



- sampleRate
- threshold
- vibration
  - x
    - accel
      - xAccelFreq
      - xAccelTime
    - veloc
      - xVelocFreq
      - xVelocTime
  - y
    - accel
      - yAccelFreq
      - yAccelTime
    - veloc
      - yVelocFreq
      - yVelocTime
  - z
    - accel
      - zAccelFreq
      - zAccelTime
    - veloc
      - zVelocFreq
      - zVelocTime
- vibrationStat

From software version 1.5.1 on, the “***vibration***” node also contains the y ordinate and x abscissa values as separate sub nodes (xAccelTimeAbscissa, xAccelTimeOrdinate…) to be suitable for software packages that cannot read the xAccelTime, xVelocTime… container structures.



- vibration
  - x
    - accel
      - xAccelFreq
      - xAccelFreqAbscissa
      - xAccelFreqOrdinate
      - xAccelTime
      - xAccelTimeAbscissa
      - xAccelTimeOrdinate
    - veloc
      - xVelocFreq
      - xVelocFreqAbscissa
      - xVelocFreqOrdinate
      - xVelocTime
      - xVelocTimeAbscissa
      - xVelocTimeOrdinate

3.6.21 Vibration statistic

The “***vibrationStat***” node contains the selected vibration statistic in the Statistics Lab (“Statistic” value in the Statistics Lab under the Units tab).

3.6.22 DFT averaging

The “***vibrationavg***” node contains the number of averages used in the DFT averaging (“DFT Averaging” setting in the Vibration Lab under the “1X” averaging tab).

From software version 1.4.17 on, the “***vibrationavg***” node has been renamed to “***averaging***”.

3.6.23 1/f noise detrending

The “***vibrationdetrend***” node shows if 1/f flicker noise detrending is activated or not (“1/f detrend” slider in the Vibration Lab under the “6Hz” High Pass Filter tab).

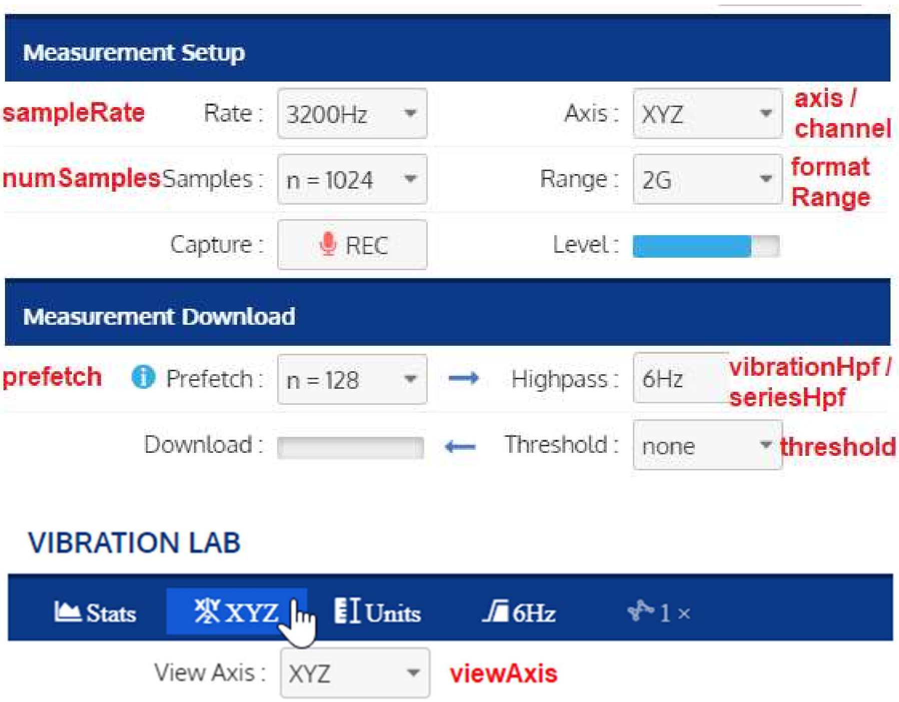
3.6.24 Highpass filter

The “***vibrationhpf***” node contains the high pass cut off frequency (“Highpass” setting in the Measurement Download pane, in the Vibration Lab under the “6Hz” High Pass Filter tab and in the Statistics lab under the “6Hz” High Pass Filter tab).

From software version 1.4.17 on, the “***vibrationhpf***” node has been renamed to “***seriesHpf***”.

3.6.25 Display units

The “***vunits***” node contains the selected display units for the vibration lab or for the vibration statistics in the Statistics Lab (“Units” value in the Vibration Lab or in the Statistics Lab under the Units tab).



Measurement Setup

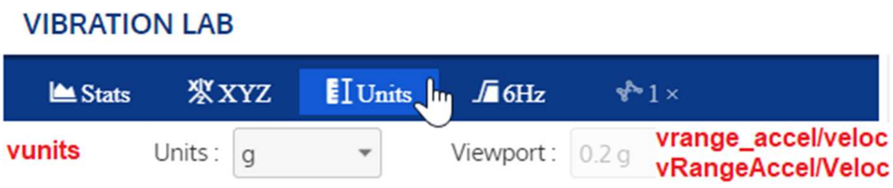
Rate : 3200Hz
Axis : XYZ
Samples : n = 1024
Range : 2G
Capture : REC
Level :

Measurement Download

Prefetch : n = 128
Highpass : 6Hz
Download :
Threshold : none

VIBRATION LAB

View Axis : XYZ

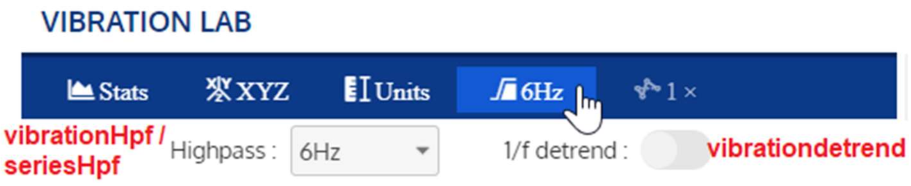


vunits

Units : g

Viewport : 0.2 g

vrange_accel/veloc
vRangeAccel/Veloc

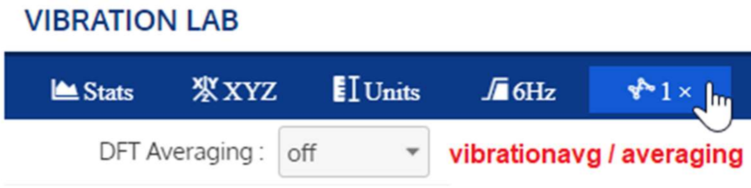


vibrationHpf /
seriesHpf

Highpass : 6Hz

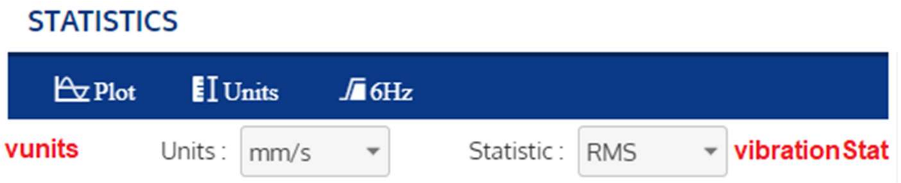
1/f detrend :

vibrationdetrend



DFT Averaging : off

vibrationavg / averaging

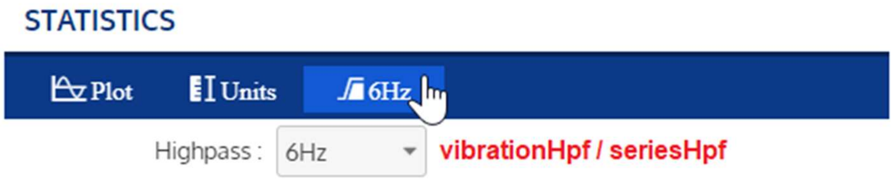


vunits

Units : mm/s

Statistic : RMS

vibrationStat



Highpass : 6Hz

vibrationHpf / seriesHpf

3.7 IEPE Piezoelectric Accelerometer nodes (available from software version 1.4.17)

3.7.1 Acceleration measurement data

The “***accelerationPack***” node contains the last recorded raw vibration data.

The ***accelerationPack*** format is as follows:

1/ numSamples: n = #samples
2/ accelArray: rawSample[0:n-1]
3/ sampleRate: e.g. 3906 = 3906Hz
4/ formatRange: e.g. 3300 = 3300mV (dynamic range of the sensor)
5/ offset: unused, 0 (hardware offset of the sensor)
6/ encoded_axis: X = 0, Y = 1, Z = 2
7/ prescaler: unused (only used when no compression in debug mode)
8/ compression: unused (0 = no compression in debug mode, 1 = compression)

You will see that the first 7 samples of the accelArray (at the start of each measurement) show a transient response due to the start-up behavior of the compression algorithm. Since a Hanning window is used for the calculation of the DFT and RMS, this behavior will be automatically suppressed and thus has no further impact.

The conversion of the accelArray to g units is as follows:

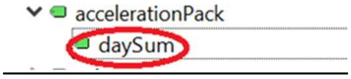
Conversion of rawSample[0:n-1] to [g]:

gSample = (((rawSample[0:n-1] * formatRange [mV]) / (2**numBits)) / convFactor) * 2
gTimes = [0:n-1]/sampleRate [sec]
with:

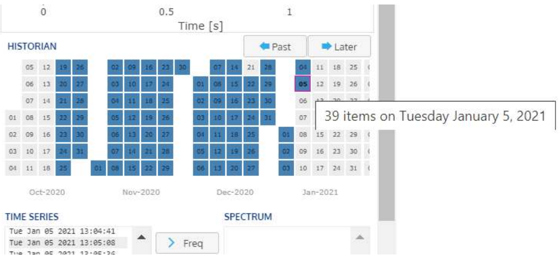
- numBits = 32
- convFactor = conversion factor from mV to g units depending on the used sensor (see section 3.7.8)

3.7.2 Number of downloads per day

The “***daySum***” node contains the number of downloaded measurements per day.



Remark: the daySum value in OPC UA can differ from the number of measurements listed in the calendar on the iQunet Sensor Dashboard since OPC uses UTC time to align the day.



39 items on Tuesday January 5, 2021

```
Tue Jan 05 2021 13:04:41
Tue Jan 05 2021 13:05:08
```

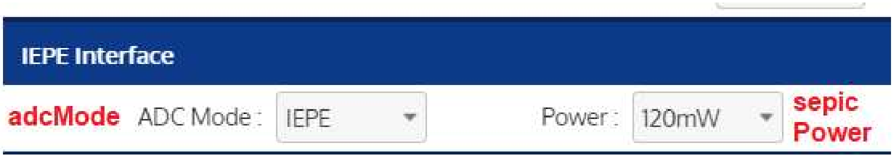
Remark: the total number of measurements/captures made per day is shown in section 3.7.17.

3.7.3 ADC mode

The "***adcMode***" node represents the selected ADC mode ("ADC Mode" setting in the IEPE Interface pane). The selected ADC mode (voltage or current) depends on the used type of measurement device.

3.7.4 Sepic power

The "***sepicPower***" node represents the maximum power level sent to the measurement device ("Power" setting in the IEPE Interface pane). The power is used to drive the built-in amplifier.


IEPE Interface

adcMode ADC Mode : IEPE

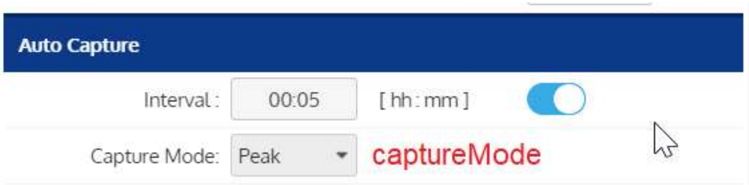
Power : 120mW sepic Power

3.7.5 Measurement axis

The "***channel***" node represents the measurement axis ("Axis" setting in the Measurement Setup or Capture Setup pane).

3.7.6 Capture mode (available from software version 1.5.0)

The "***captureMode***" node represents the selected capture mode ("Capture Mode" setting in the Auto Capture or Capture Interval pane). The capture mode can be set to "peak" (measurement with the highest peak power during the set measurement interval is saved) or "instant" (measurement is taken at the end of the set measurement interval).


Auto Capture

Interval : 00:05 [hh : mm]

Capture Mode: Peak captureMode

3.7.7 Number of measurements per setting

The "***captureStats***" node displays the number of measurements made per setting when its callback function is called.

3.7.8 Conversion factor

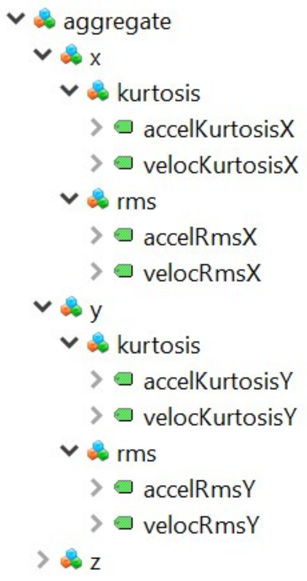
The "***convFactor***" node contains a conversion factor. This conversion factor is deduced from the sensitivity level set in the iQunet Sensor Dashboard ("Sens" setting in the Measurement Setup or Capture Setup pane).

3.7.9 Dynamic range

The "***formatRange***" node represents the dynamic range of the sensor. For the IEPE accelerometer this setting is fixed to 3300mV (the range of the used ADC unit).

3.7.10 Statistics values (Kurtosis and RMS)

The "***aggregate***" node contains a custom OPC UA data container structure containing the last calculated RMS and Kurtosis statistics on the X, Y and Z axis. The data structure contains the acceleration (accel) and velocity (veloc) Kurtosis statistics (accelKurtosisX, velocKurtosisX) and RMS statistics (accelRmsX, velocRmsX) for each axis (X, Y and Z).



3.7.11 Number of samples

The “***numSamples***” node contains the number of measurement samples (“Samples” setting in the Measurement Setup or Capture Setup pane).

3.7.12 Number of prefetch samples (for software versions up to 1.6.2)

The “***prefetch***” node contains the number of prefetch samples (“Prefetch” setting in the Measurement Download pane).

3.7.13 Sampling rate

The “***sampleRate***” node represents the sampling rate of the sensor (“Rate” setting in the Measurement Setup or Capture Setup pane).

3.7.14 Anomaly Detection models

The “***tensorFlow***” node shows the calculated Anomaly Detection models underneath the “***models***” sub node (if there are models available).

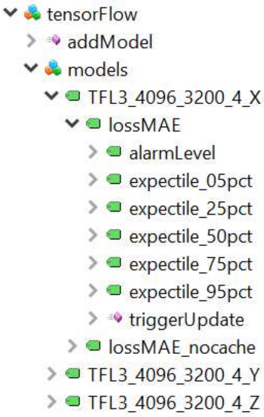
If you click on the arrow next to the “***tensorFlow***” name in UA Expert, the “***models***” sub node will appear. If there are models available for this sensor, you can open the “***models***” node by clicking on the arrow icon. All models created for this sensor will appear. The models will have the same names as in the iQunet Sensor Dashboard.

For each model, the following AI parameters can be extracted:

- “***lossMAE***” node: Raw prediction error (“raw” signal in the figure in the iQunet Sensor Dashboard)
- “***Expectile_05pct***” node: Expectile 5% (“LO 5%” signal in the figure in the iQunet Sensor Dashboard)
- “***Expectile_25pct***” node: Expectile 25%
- “***Expectile_50pct***” node: Expectile 50% (“median” signal in the figure in the iQunet Sensor Dashboard)
- “***Expectile_75pct***” node: Expectile 75%
- “***Expectile_95pct***” node: Expectile 95% (“HI 95%” signal in the figure in the iQunet Sensor Dashboard)
- “***alarmLevel***” node: the alarm level set in the iQunet Sensor Dashboard

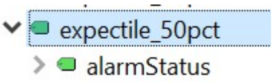
Remark: anomaly data is calculated from the start of the model's training period. Data older than the timestamp of the start of the training period will not be displayed in the Anomaly Monitor in the iQunet Sensor Dashboard nor in OPC UA.

The "***triggerUpdate***" node contains a callback function which recalculates and updates the AI model plot in the iQunet Sensor Dashboard when called.



- tensorFlow
  - addModel
  - models
    - TFL3_4096_3200_4_X
      - lossMAE
        - alarmLevel
        - expectile_05pct
        - expectile_25pct
        - expectile_50pct
        - expectile_75pct
        - expectile_95pct
        - triggerUpdate
      - lossMAE_nocache
    - TFL3_4096_3200_4_Y
    - TFL3_4096_3200_4_Z

Underneath every expectile, you can also find an "***alarmStatus***" sub node (alarm status is false if the latest value of the expectile is lower than the set alarm level, true if the latest value is above the set alarm level).



- expectile_50pct
  - alarmStatus

3.7.15 Vibration download threshold

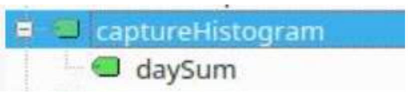
The "***threshold***" node contains the threshold level for full vibration download ("Threshold" setting in the Measurement Download or Download Filter pane).

3.7.16 Capture histogram (available from software version 1.6.3)

The "***captureHistogram***" node contains the calculated peak power histogram used to compare with the threshold level for full vibration download (blue bars in the histogram graph in the Download Filter pane).

3.7.17 Number of measurements (available from software version 1.6.12)

The "***daySum***" node (located underneath the "***captureHistogram***" node) represents the total number of measurements or captures made per day.

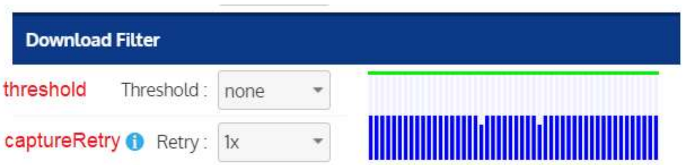


- captureHistogram
  - daySum

Remark: the number of measurements that have actually been downloaded is shown in the "***daySum***" node located underneath the "***accelerationPack***" node (see 3.7.2).

3.7.18 Capture retries (available from software version 1.6.3)

The "***captureRetry***" node contains the number of capture attempts in each measurement interval if the threshold level is not yet exceeded ("Retry" setting in the Download Filter pane).



Download Filter

threshold Threshold : none

captureRetry Retry : 1x

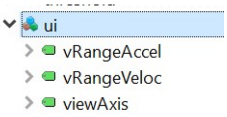
3.7.19 User Interface settings

The “*ui*” node contains User Interface settings.

The underlying “***viewAxis***” node shows the view axis selector setting (“viewAxis” setting in the Vibration Lab under the “XYZ” view axis selector tab).

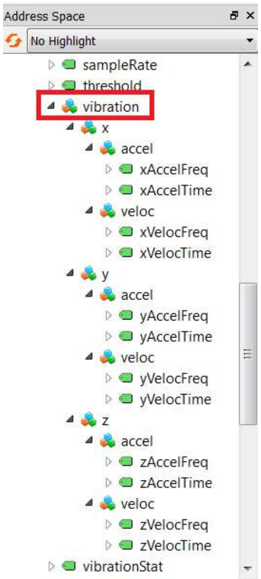
The underlying “***vRangeAccel***” node represents the viewport range in g units in the Vibration Lab (“Viewport” setting in the Vibration Lab under the Units tab).

The underlying “***vRangeVeloc”*** node represents the viewport range in mm/s units in the Vibration Lab (“Viewport” setting in the Vibration Lab under the Units tab).

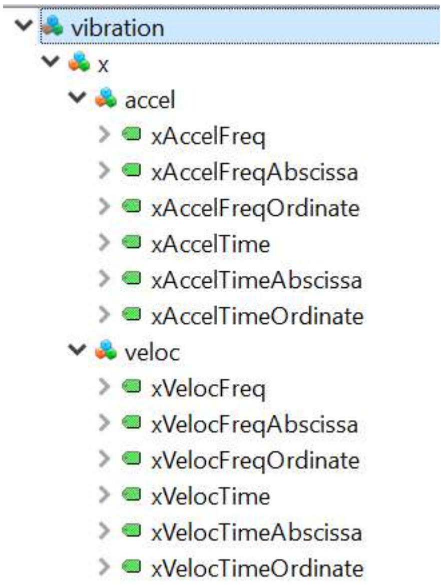


3.7.20 Vibration measurement data

The “***vibration***” node contains a custom OPC UA data container structure containing the last recorded vibration data on the X, Y and Z axis. The data structure contains the acceleration (accel) and velocity (veloc) data in the time (xAccelTime, xVelocTime) and frequency domain (xAccelFreq, xVelocFreq) for each axis (X, Y and Z).



From software version 1.5.1 on, the “***vibration***” node also contains the y ordinate and x abscissa values as separate sub nodes (xAccelTimeAbscissa, xAccelTimeOrdinate…) to be suitable for software packages that cannot read the xAccelTime, xVelocTime… container structures.



- vibration
  - x
    - accel
      - xAccelFreq
      - xAccelFreqAbscissa
      - xAccelFreqOrdinate
      - xAccelTime
      - xAccelTimeAbscissa
      - xAccelTimeOrdinate
    - veloc
      - xVelocFreq
      - xVelocFreqAbscissa
      - xVelocFreqOrdinate
      - xVelocTime
      - xVelocTimeAbscissa
      - xVelocTimeOrdinate

3.7.21 Vibration statistic

The “***vibrationStat***” node contains the selected vibration statistic in the Statistics Lab (“Statistic” value in the Statistics Lab under the Units tab).

3.7.22 DFT averaging

The “***averaging***” node contains the number of averages used in the DFT averaging (“DFT Averaging” setting in the Vibration Lab under the “1X” averaging tab).

3.7.23 1/f noise detrending

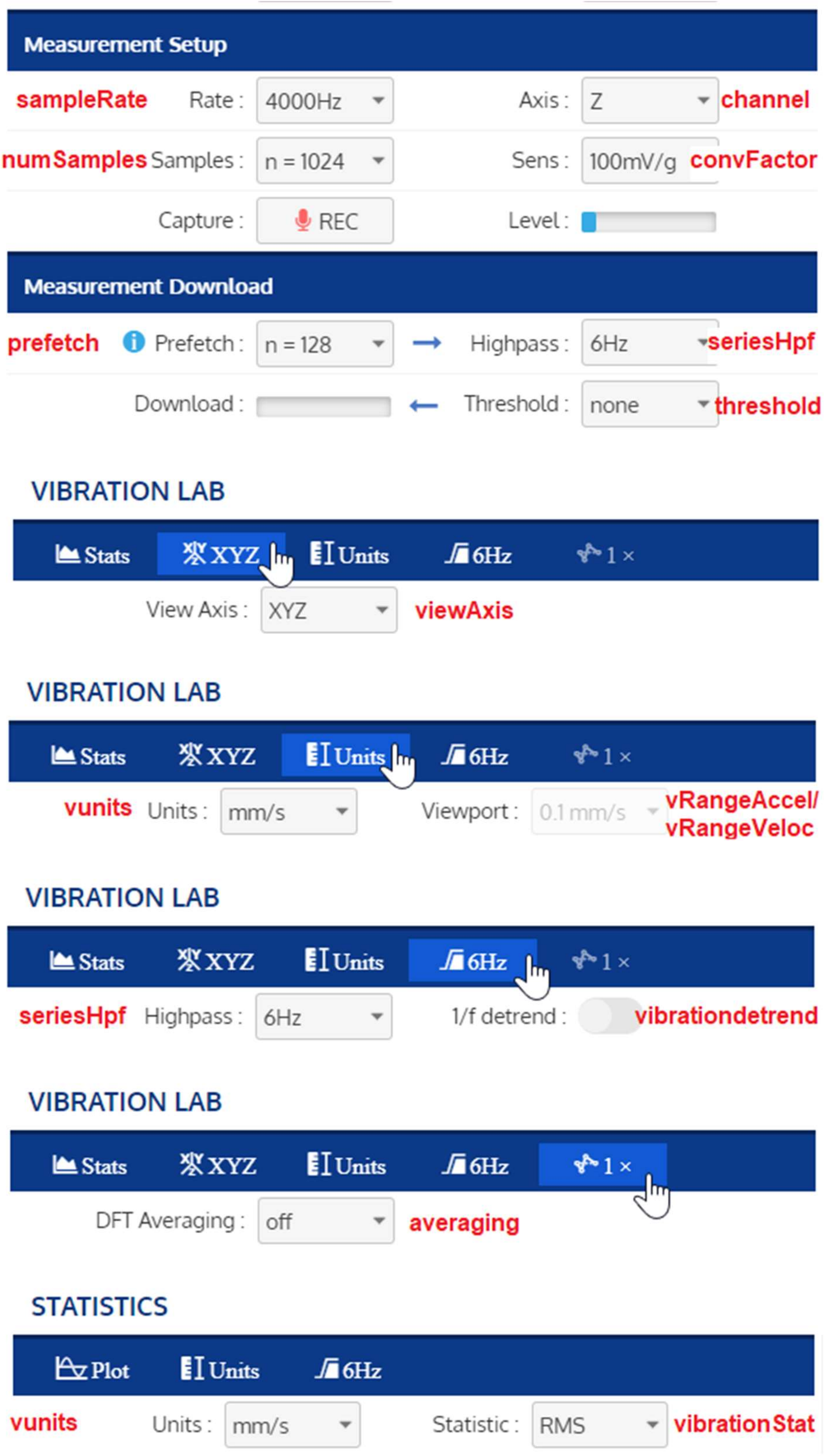
The “***vibrationdetrend***” node shows if 1/f flicker noise detrending is activated or not (“1/f detrend” slider in the Vibration Lab under the “6Hz” High Pass Filter tab).

3.7.24 Highpass filter

The “***seriesHpf***” node contains the high pass cut off frequency (“Highpass” setting in the Measurement Download pane, in the Vibration Lab under the “6Hz” High Pass Filter tab and in the Statistics lab under the “6Hz” High Pass Filter tab).

3.7.25 Display units

The “***vunits***” node contains the selected display units for the vibration lab or for the vibration statistics in the Statistics Lab (“Units” value in the Vibration Lab or in the Statistics Lab under the Units tab).



Measurement Setup

sampleRate Rate : 4000Hz — Axis : Z channel

numSamples Samples : n = 1024 — Sens : 100mV/g convFactor

Capture : REC — Level :

Measurement Download

prefetch Prefetch : n = 128 → Highpass : 6Hz seriesHpf

Download : ← Threshold : none threshold

VIBRATION LAB

View Axis : XYZ viewAxis

VIBRATION LAB

vunits Units : mm/s — Viewport : 0.1 mm/s vRangeAccel/ vRangeVeloc

VIBRATION LAB

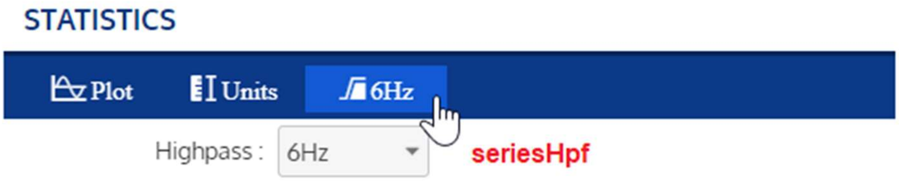
seriesHpf Highpass : 6Hz — 1/f detrend : vibrationdetrend

VIBRATION LAB

DFT Averaging : off averaging

STATISTICS

vunits Units : mm/s — Statistic : RMS vibrationStat



Highpass : 6Hz

3.8 Current Clamp nodes (available from software version 1.4.17)

3.8.1 Measurement data

The “***accelerationPack***” node contains the last recorded raw measurement data.

The ***accelerationPack*** format is as follows:

1/ numSamples: n = #samples
2/ accelArray: rawSample[0:n-1]
3/ sampleRate: e.g. 3906 = 3906Hz
4/ formatRange: e.g. 3300 = 3300mV (dynamic range of the sensor)
5/ offset: unused, 0 (hardware offset of the sensor)
6/ encoded_axis: X = 0, Y = 1, Z = 2
7/ prescaler: unused (only used when no compression in debug mode)
8/ compression: unused (0 = no compression in debug mode, 1 = compression)

You will see that the first 7 samples of the accelArray (at the start of each measurement) show a transient response due to the start-up behavior of the compression algorithm. Since a Hanning window is used for the calculation of the DFT and RMS, this behavior will be automatically suppressed and thus has no further impact.

The conversion of the accelArray to A units is as follows:

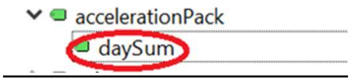
<u>Conversion of rawSample[0:n-1] to [A]:</u>

gSample = (((rawSample[0:n-1] * formatRange [mV]) / (2**numBits)) / convFactor) * 2
gTimes = [0:n-1]/sampleRate [sec]
with:

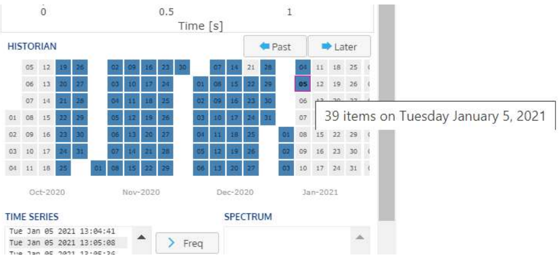
- numBits = 32
- convFactor = conversion factor from mV to A units depending on the used sensor (see section 3.8.8)

3.8.2 Number of downloads per day

The “***daySum***” node contains the number of downloaded measurements per day.



Remark: the daySum value in OPC UA can differ from the number of measurements listed in the calendar on the iQunet Sensor Dashboard since OPC uses UTC time to align the day.



39 items on Tuesday January 5, 2021

```
Tue Jan 05 2021 13:04:41
Tue Jan 05 2021 13:05:08
```

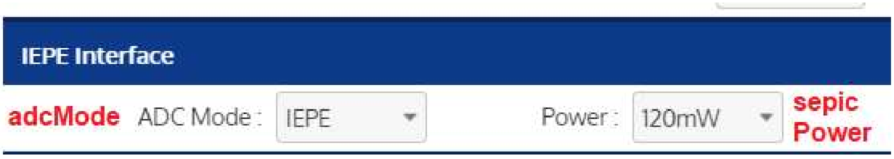
Remark: the total number of measurements/captures made per day is shown in section 3.8.17.

3.8.3 ADC mode

The "***adcMode***" node represents the selected ADC mode ("ADC Mode" setting in the IEPE Interface pane). The selected ADC mode (voltage or current) depends on the used type of measurement device.

3.8.4 Sepic power

The "***sepicPower***" node represents the maximum power level sent to the measurement device ("Power" setting in the IEPE Interface pane). The power is used to drive the built-in amplifier.



IEPE Interface

ADC Mode : IEPE

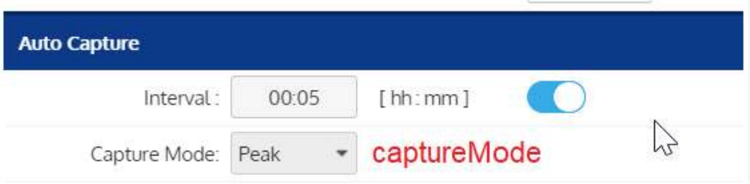
Power : 120mW

3.8.5 Measurement axis

The "***channel***" node represents the measurement axis ("Axis" setting in the Measurement Setup or Capture Setup pane).

3.8.6 Capture mode (available from software version 1.5.0)

The "***captureMode***" node represents the selected capture mode ("Capture Mode" setting in the Auto Capture or Capture Interval pane). The capture mode can be set to "peak" (measurement with the highest peak power during the set measurement interval is saved) or "instant" (measurement is taken at the end of the set measurement interval).



Auto Capture

Interval : 00:05 [hh : mm]

Capture Mode: Peak

3.8.7 Number of measurements per setting

The "***captureStats***" node displays the number of measurements made per setting when its callback function is called.

3.8.8 Conversion factor

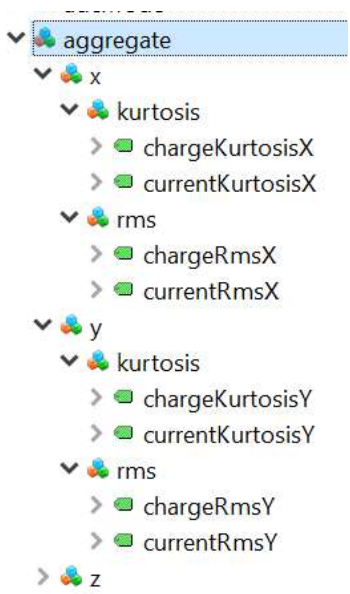
The "***convFactor***" node contains a conversion factor. This conversion factor is deduced from the sensitivity level set in the iQunet Sensor Dashboard ("Sens" setting in the Measurement Setup or Capture Setup pane).

3.8.9 Dynamic range

The "***formatRange***" node represents the dynamic range of the sensor. For the Current Clamp, this setting is fixed to 3300mV (the range of the used ADC unit).

3.8.10 Statistics values (Kurtosis and RMS)

The "***aggregate***" node contains a custom OPC UA data container structure containing the last calculated RMS and Kurtosis statistics on the X, Y and Z axis. The data structure contains the charge and current Kurtosis statistics (chargeKurtosisX, currentKurtosisX) and RMS statistics (chargeRmsX, currentRmsX) for each axis (X, Y and Z).



- aggregate
  - x
    - kurtosis
      - chargeKurtosisX
      - currentKurtosisX
    - rms
      - chargeRmsX
      - currentRmsX
  - y
    - kurtosis
      - chargeKurtosisY
      - currentKurtosisY
    - rms
      - chargeRmsY
      - currentRmsY
  - z

3.8.11 Number of samples

The “***numSamples***” node contains the number of measurement samples (“Samples” setting in the Measurement Setup or Capture Setup pane).

3.8.12 Number of prefetch samples (for software versions up to 1.6.2)

The “***prefetch***” node contains the number of prefetch samples (“Prefetch” setting in the Measurement Download pane).

3.8.13 Sampling rate

The “***sampleRate***” node represents the sampling rate of the sensor (“Rate” setting in the Measurement Setup or Capture Setup pane).

3.8.14 Anomaly Detection models

The “***tensorFlow***” node shows the calculated Anomaly Detection models underneath the “***models***” sub node (if there are models available).

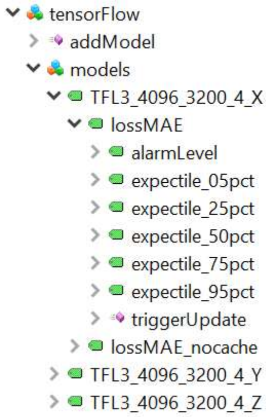
If you click on the arrow next to the “***tensorFlow***” name in UA Expert, the “***models***” sub node will appear. If there are models available for this sensor, you can open the “***models***” node by clicking on the arrow icon. All models created for this sensor will appear. The models will have the same names as in the iQunet Sensor Dashboard.

For each model, the following AI parameters can be extracted:

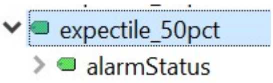
- “***lossMAE***” node: Raw prediction error (“raw” signal in the figure in the iQunet Sensor Dashboard)
- “***Expectile_05pct***” node: Expectile 5% (“LO 5%” signal in the figure in the iQunet Sensor Dashboard)
- “***Expectile_25pct***” node: Expectile 25%
- “***Expectile_50pct***” node: Expectile 50% (“median” signal in the figure in the iQunet Sensor Dashboard)
- “***Expectile_75pct***” node: Expectile 75%
- “***Expectile_95pct***” node: Expectile 95% (“HI 95%” signal in the figure in the iQunet Sensor Dashboard)
- “***alarmLevel***” node: the alarm level set in the iQunet Sensor Dashboard

Remark: anomaly data is calculated from the start of the model's training period. Data older than the timestamp of the start of the training period will not be displayed in the Anomaly Monitor in the iQunet Sensor Dashboard nor in OPC UA.

The "***triggerUpdate***" node contains a callback function which recalculates and updates the AI model plot in the iQunet Sensor Dashboard when called.



Underneath every expectile, you can also find an "***alarmStatus***" sub node (alarm status is false if the latest value of the expectile is lower than the set alarm level, true if the latest value is above the set alarm level).



3.8.15 Measurement download threshold

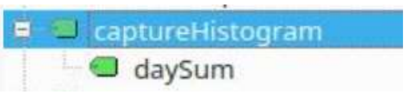
The "***threshold***" node contains the threshold level for full measurement download ("Threshold" setting in the Measurement Download or Download Filter pane).

3.8.16 Capture histogram (available from software version 1.6.3)

The "***captureHistogram***" node contains the calculated peak power histogram used to compare with the threshold level for full vibration download (blue bars in the histogram graph in the Download Filter pane).

3.8.17 Number of measurements (available from software version 1.6.12)

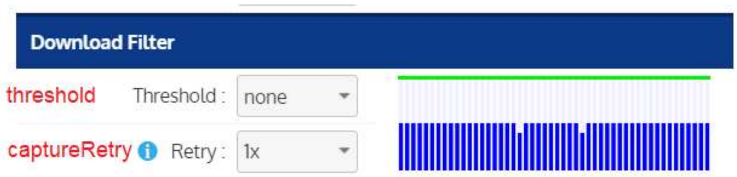
The "***daySum***" node (located underneath the "***captureHistogram***" node) represents the total number of measurements or captures made per day.



Remark: the number of measurements that have actually been downloaded is shown in the "***daySum***" node located underneath the "***accelerationPack***" node (see 3.8.2).

3.8.18 Capture retries (available from software version 1.6.3)

The "***captureRetry***" node contains the number of capture attempts in each measurement interval if the threshold level is not yet exceeded ("Retry" setting in the Download Filter pane).



Download Filter

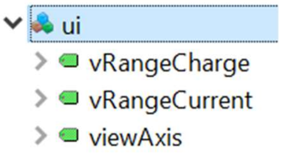
threshold	Threshold :	none
captureRetry	Retry :	1x

3.8.19 User interface settings

The “***ui***” node contains User Interface settings.

The underlying “***viewAxis***” node shows the view axis selector setting (“viewAxis” setting in the Current Monitor under the “XYZ” view axis selector tab).
The underlying “***vRangeCharge***” node represents the viewport range in A.s units in the Current Monitor (“Viewport” setting in the Current Monitor under the Units tab).

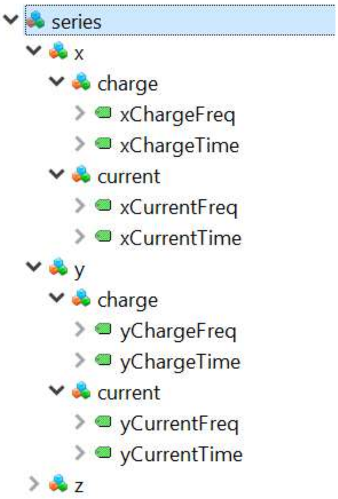
The underlying “***vRangeCurrent”*** node represents the viewport range in A units in the Current Monitor (“Viewport” setting in the Current Monitor under the Units tab).



- ui
  - vRangeCharge
  - vRangeCurrent
  - viewAxis

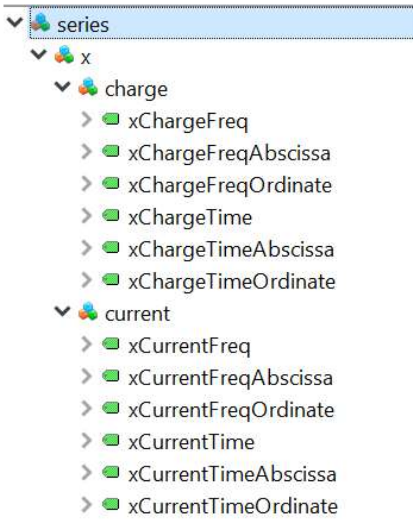
3.8.20 Measurement data

The “***series***” node contains a custom OPC UA data container structure containing the last recorded measurement data on the X, Y and Z axis. The data structure contains the charge and current data in the time (xChargeTime, xCurrentTime) and frequency domain (xChargeFreq, xCurrentFreq) for each axis (X, Y and Z).



- series
  - x
    - charge
      - xChargeFreq
      - xChargeTime
    - current
      - xCurrentFreq
      - xCurrentTime
  - y
    - charge
      - yChargeFreq
      - yChargeTime
    - current
      - yCurrentFreq
      - yCurrentTime
  - z

From software version 1.5.1 on, the “***series***” node also contains the y ordinate and x abscissa values as separate sub nodes (xChargeTimeAbscissa, xChargeTimeOrdinate…) to be suitable for software packages that cannot read the xChargeTime, xCurrentTime… container structures.



```
series
  x
    charge
      xChargeFreq
      xChargeFreqAbscissa
      xChargeFreqOrdinate
      xChargeTime
      xChargeTimeAbscissa
      xChargeTimeOrdinate
    current
      xCurrentFreq
      xCurrentFreqAbscissa
      xCurrentFreqOrdinate
      xCurrentTime
      xCurrentTimeAbscissa
      xCurrentTimeOrdinate
```

3.8.21 DFT averaging

The “***averaging***” node contains the number of averages used in the DFT averaging (“DFT Averaging” setting in the Current Monitor under the “1X” averaging tab).

3.8.22 1/f noise detrending

The “***vibrationdetrend***” node shows if 1/f flicker noise detrending is activated or not (“1/f detrend” slider in the Current Monitor under the “6Hz” High Pass Filter tab). This detrending is NOT available for current and charge spectra.

3.8.23 Vibration statistic

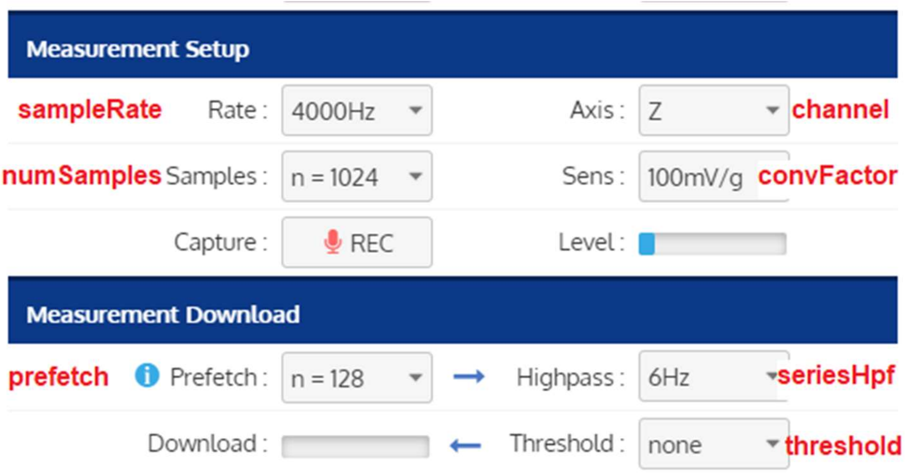
The “***vibrationStat***” node contains the selected vibration statistic in the Statistics Lab (“Statistic” value in the Statistics Lab under the Units tab).

3.8.24 Highpass filter

The “***seriesHpf***” node contains the high pass cut off frequency (“Highpass” setting in the Measurement Download pane, in the Vibration Lab under the “6Hz” High Pass Filter tab and in the Statistics lab under the “6Hz” High Pass Filter tab).

3.8.25 Display units

The “***vunits***” node contains the selected display units for the Current Monitor or for the statistics in the Statistics Lab (“Units” value in the Current Monitor or in the Statistics Lab under the Units tab).



Measurement Setup

sampleRate Rate : 4000Hz

Axis : Z channel

numSamples Samples : n = 1024

Sens : 100mV/g convFactor

Capture : REC

Level :

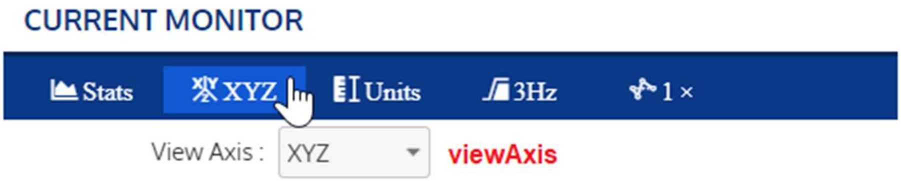
Measurement Download

prefetch Prefetch : n = 128 →

Highpass : 6Hz seriesHpf

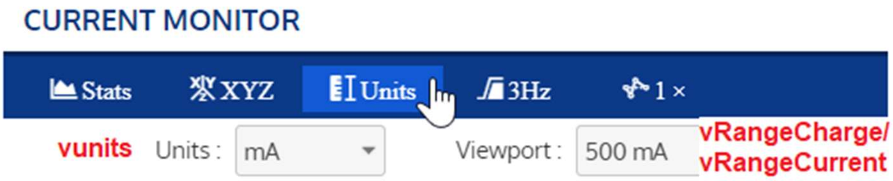
Download : ←

Threshold : none threshold



CURRENT MONITOR

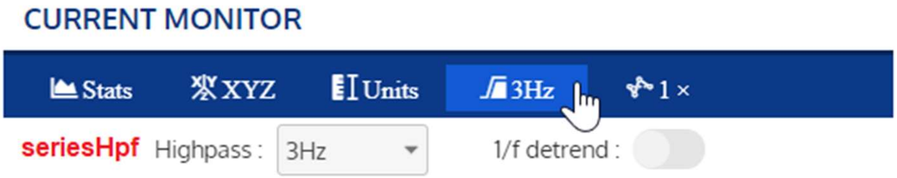
View Axis : XYZ viewAxis



CURRENT MONITOR

vunits Units : mA

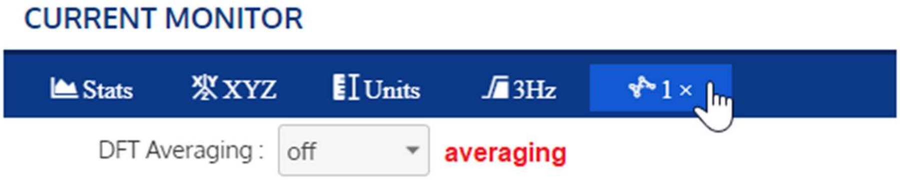
Viewport : 500 mA vRangeCharge/vRangeCurrent



CURRENT MONITOR

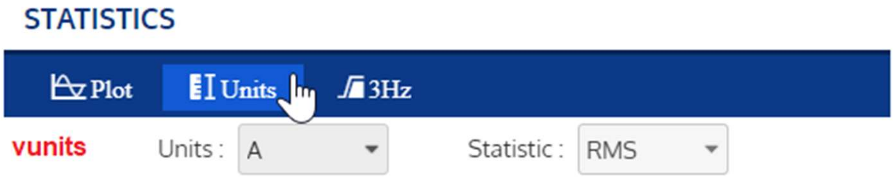
seriesHpf Highpass : 3Hz

1/f detrend :



CURRENT MONITOR

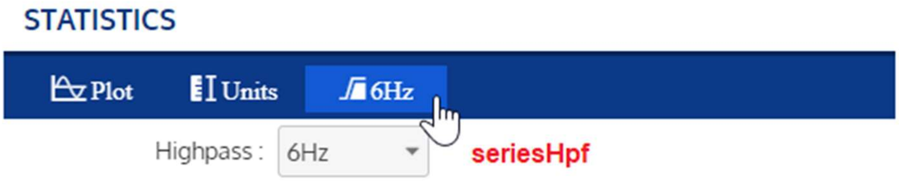
DFT Averaging : off averaging



STATISTICS

vunits Units : A

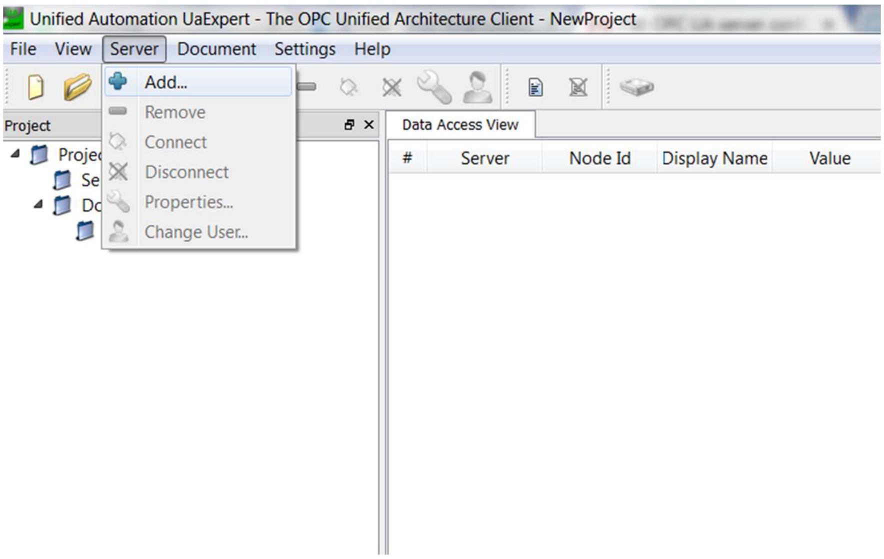
Statistic : RMS



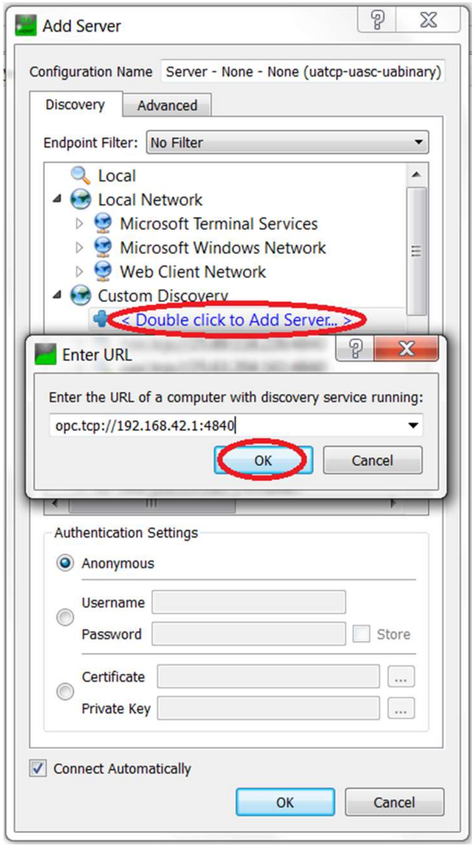
Highpass : 6Hz seriesHpf

4 Example using UA Expert

To extract data via OPC, you can use UAExpert for example.
Open UA Expert and click on Server → Add.



Double click on "Double click to Add Server" and fill out the IP address behind “opc.tcp://” followed by “:4840”. Click OK.



Configuration Name: Server - None - None (uatcp-uasc-uabinary)

Endpoint Filter: No Filter

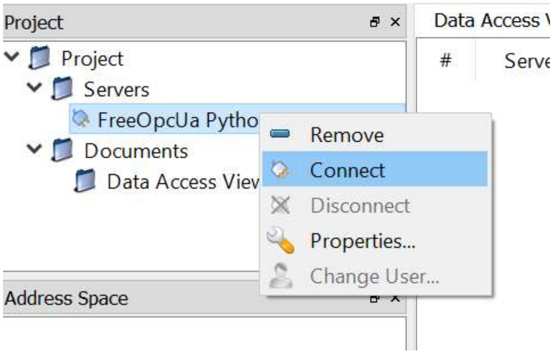
Enter the URL of a computer with discovery service running:
opc.tcp://192.168.42.1:4840

● Anonymous

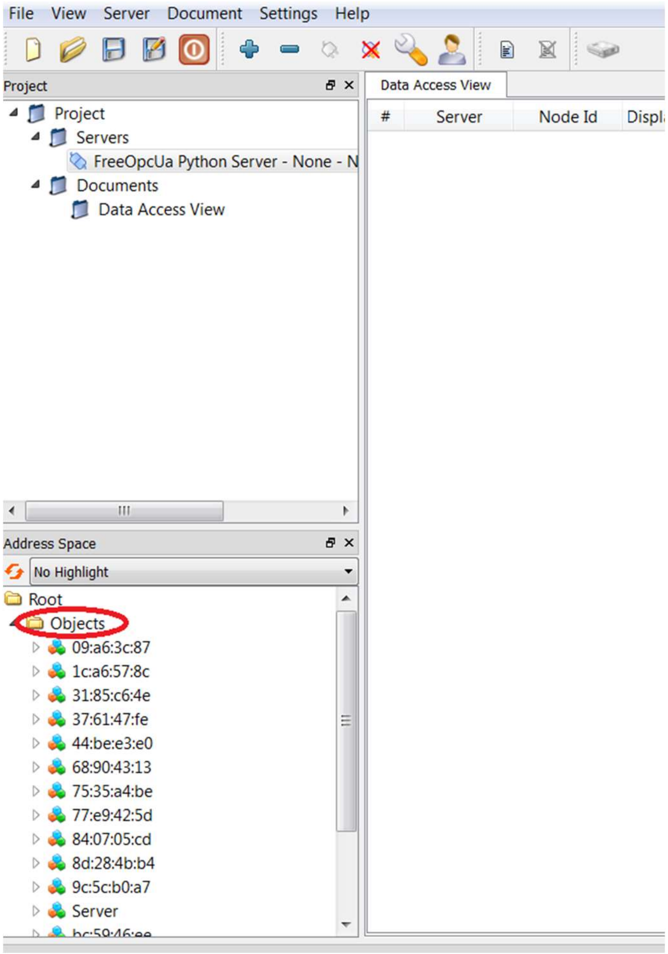
☑ Connect Automatically

Select the added server in the server list. Double click on it twice and select the desired encryption method to add the server to the project. If asked, accept the server's certificate.

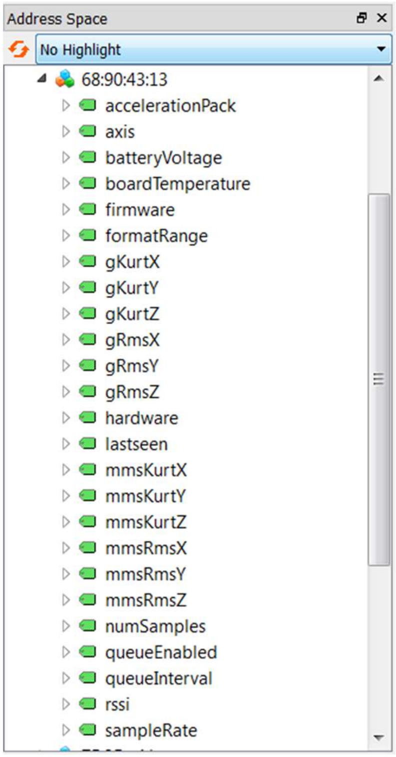
Right-click on the "FreeOpcUa Python Server" added to the project and click on "Connect" if the server is not connected automatically yet.



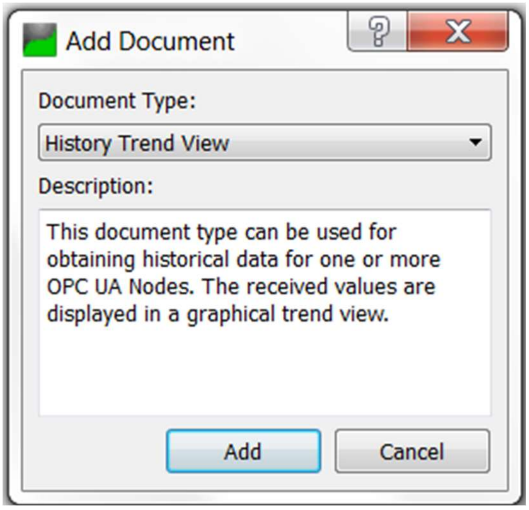
All sensors connected to this server will appear in the Address Space.



Click on the macId of the sensor to see all possible attributes of the sensor.



Add a document to inspect for example the board temperature data (Document → Add). Select ‘History Trend View’ as the document type and click ‘Add’.


Add Document

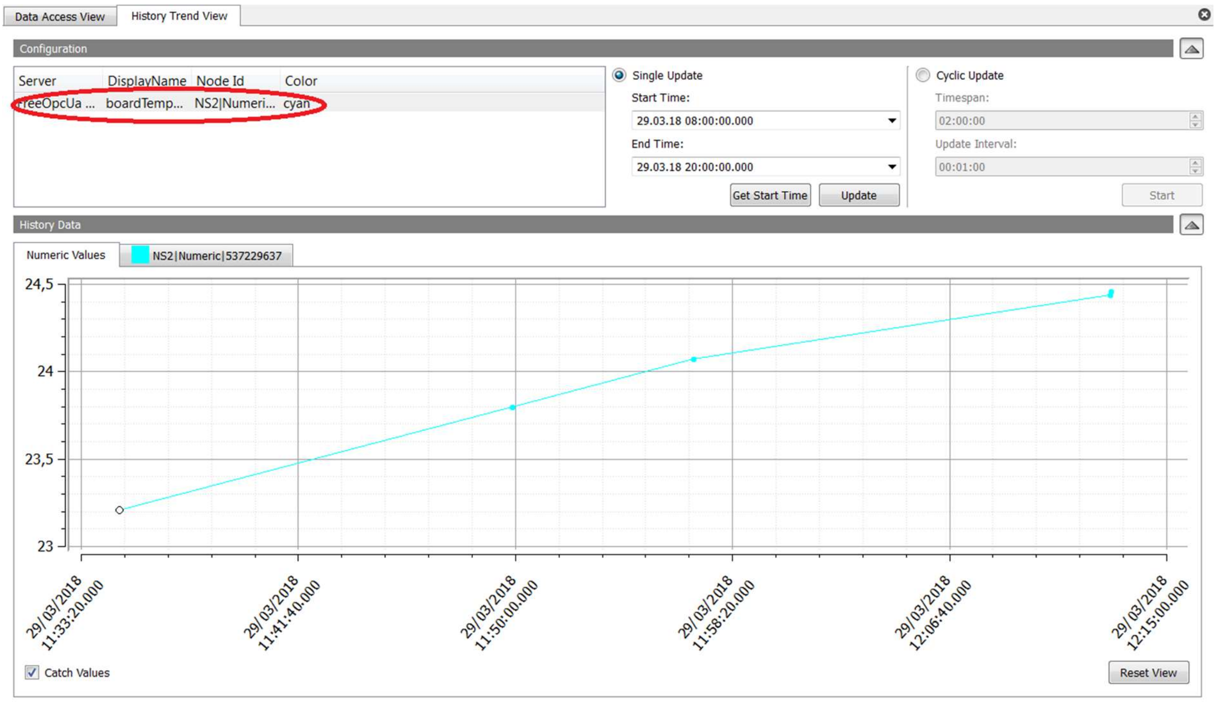
Document Type: History Trend View

Description:

This document type can be used for obtaining historical data for one or more OPC UA Nodes. The received values are displayed in a graphical trend view.

USER MANUAL

Drag the boardTemperature attribute of the sensor to the configuration window.



Server	DisplayName	Node Id	Color
reeOpcUa ...	boardTemp...	NS2|Numeri...	cyan

● Single Update
Start Time: 29.03.18 08:00:00.000
End Time: 29.03.18 20:00:00.000

○ Cyclic Update
Timespan: 02:00:00
Update Interval: 00:01:00

🟦 NS2|Numeric|537229637

☑ Catch Values

Temperature read-out is possible via either a single update that extracts all data values in between two points of time at once or via a cyclic update that extracts all data over the set timespan every set time interval (update interval).

The accelerationPack attribute contains the raw vibration data. The accelerationPack format is as follows:

1/ numSamples: n = #samples
2/ accelArray: rawSample[0:n-1]
3/ sampleRate: e.g. 400 = 400Hz
4/ formatRange: e.g. 4 = +/-4g (hardware setting of the accelerometer IC)
5/ offset: unused, 0 (hardware offset of the accelerometer IC)
6/ encoded_axis: X = 0, Y = 1, Z = 2
7/ prescaler: unused (only used when no compression in debug mode)
8/ compression: unused (0 = no compression in debug mode, 1 = compression)

You will see that the first 7 samples of the accelArray (at the start of each measurement) show a transient response due to the start-up behavior of the compression algorithm. Since a Hanning window is used for the calculation of the DFT and RMS, this behavior will be automatically suppressed and has thus no further impact.

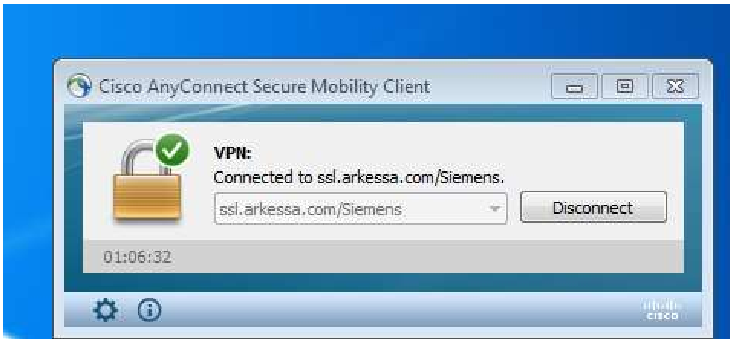
The conversion of the accelArray to g units is as follows (for the battery-powered and cable-powered Vibration Sensors):

<u>Conversion of rawSample[0:n-1] to [g]:</u>

gSample = (rawSample[0:n-1]/512.0) * formatRange [g]
gTimes = [0:n-1]/sampleRate [sec]

5 Example using TIA Portal V15 WinCC RT Advanced

Connect to the iQunet Server. In this example, the connection is set-up via VPN with IP address 10.50.29.1. Note that other connection methods can be used as well. See the resources page on the iQunet website (Knowledge Base) for more information.



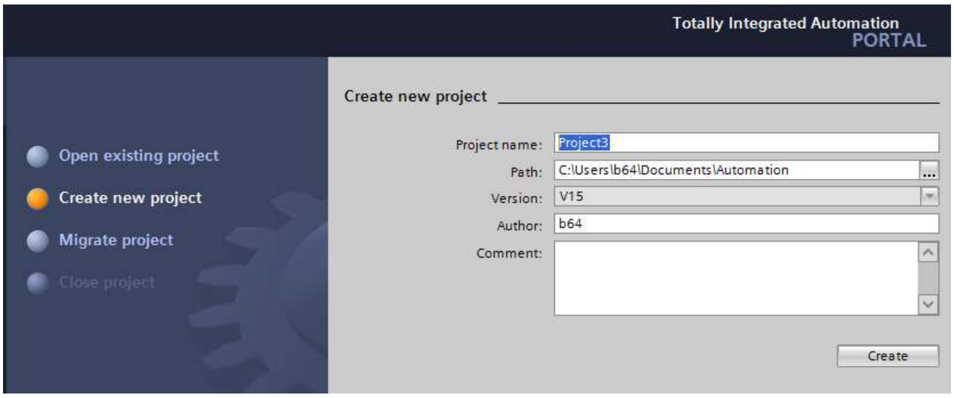
Cisco AnyConnect Secure Mobility Client

VPN:
Connected to ssl.arkessa.com/Siemens.

ssl.arkessa.com/Siemens

01:06:32

Open TIA Portal V15 and select “Create new project”.

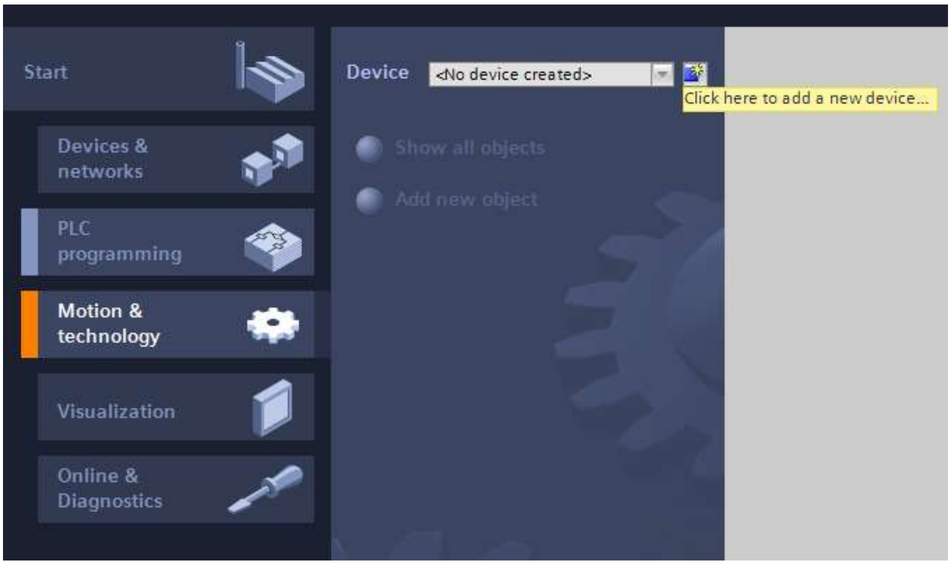


Totally Integrated Automation PORTAL

Create new project

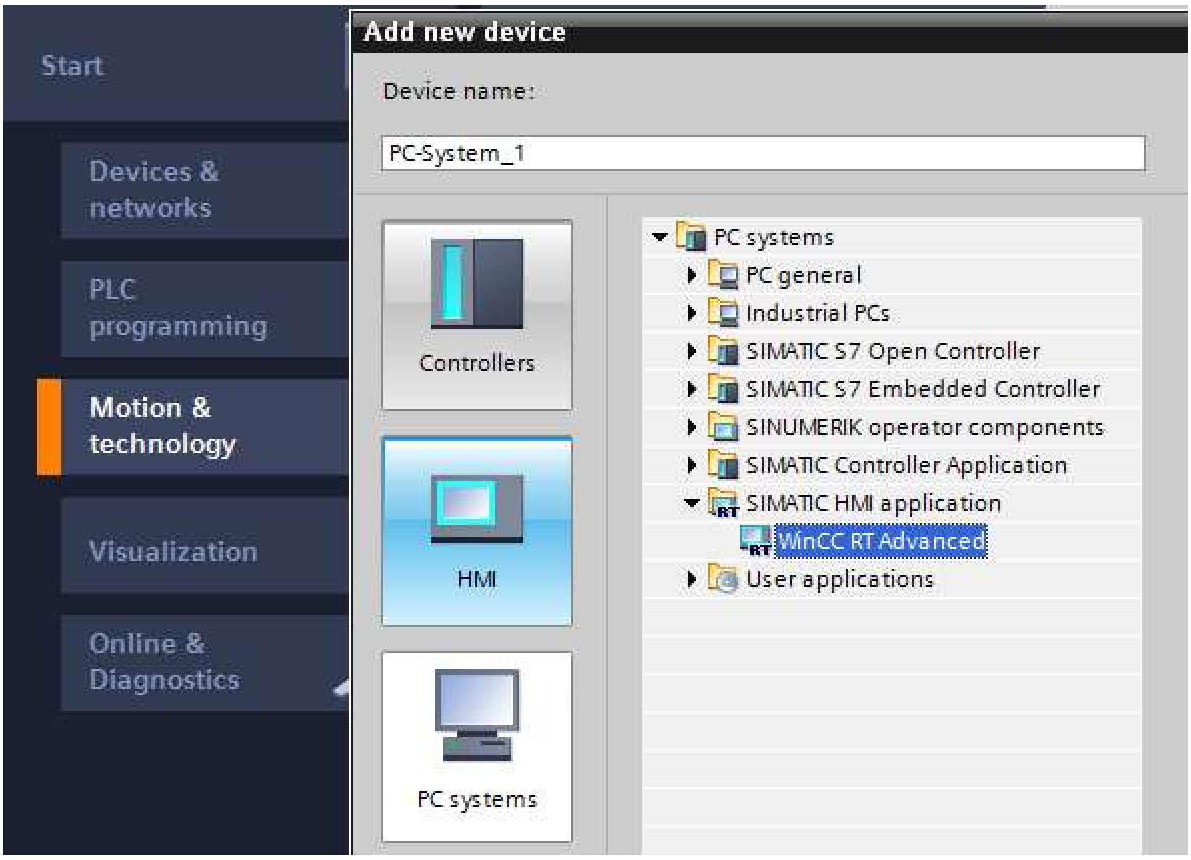
Project name: Project3
Path: C:\Users\b64\Documents\Automation
Version: V15
Author: b64
Comment:

Select “Motion & technology” and click on the button on the right to add a new device.



Device <No device created>

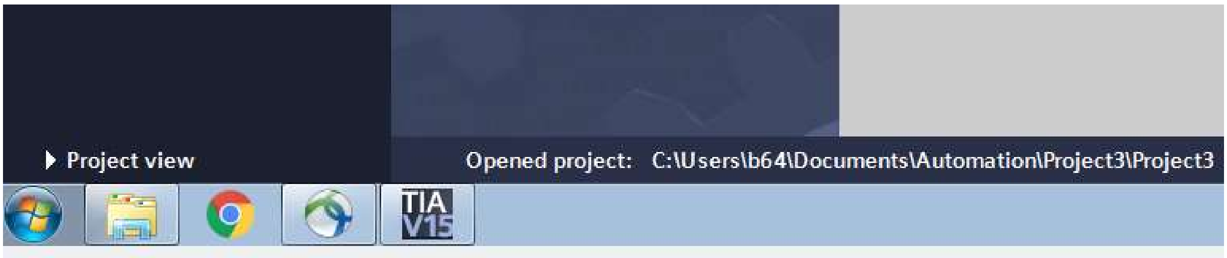
Select PC systems → SIMATIC HMI application → WinCC RT Advanced and click OK.



Add new device

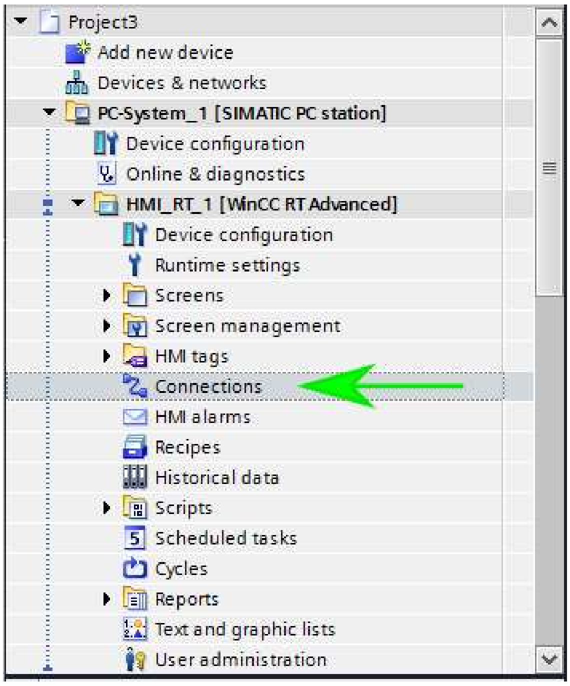
Device name: PC-System_1

Open the project view.

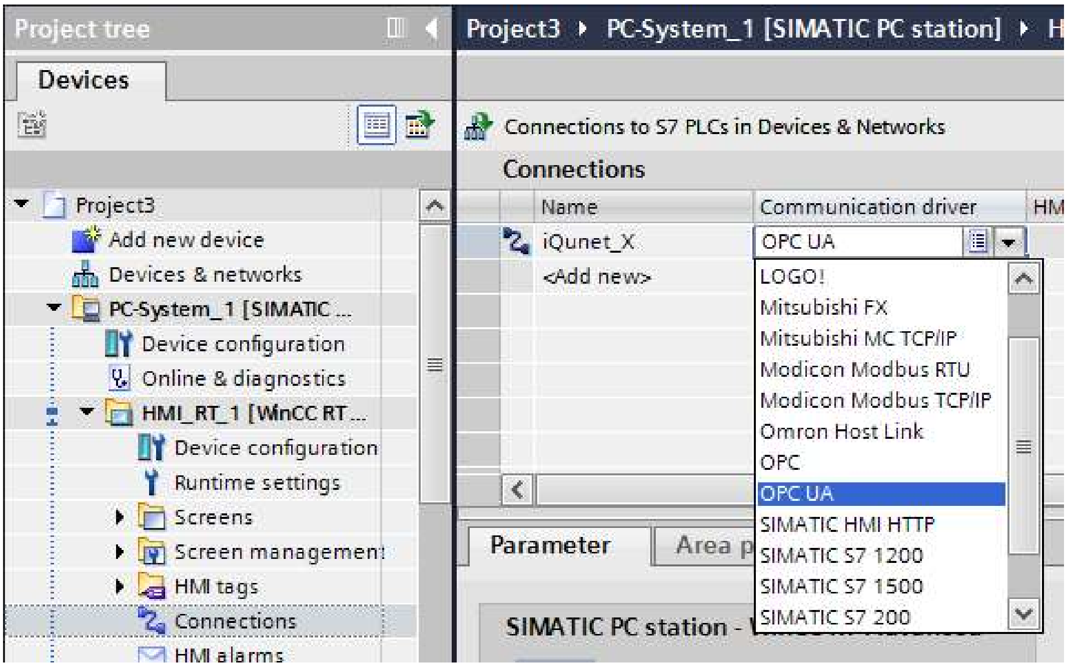


Opened project: C:\Users\b64\Documents\Automation\Project3\Project3

Select PC-System_1 → HMI_RT_1 → Connections.

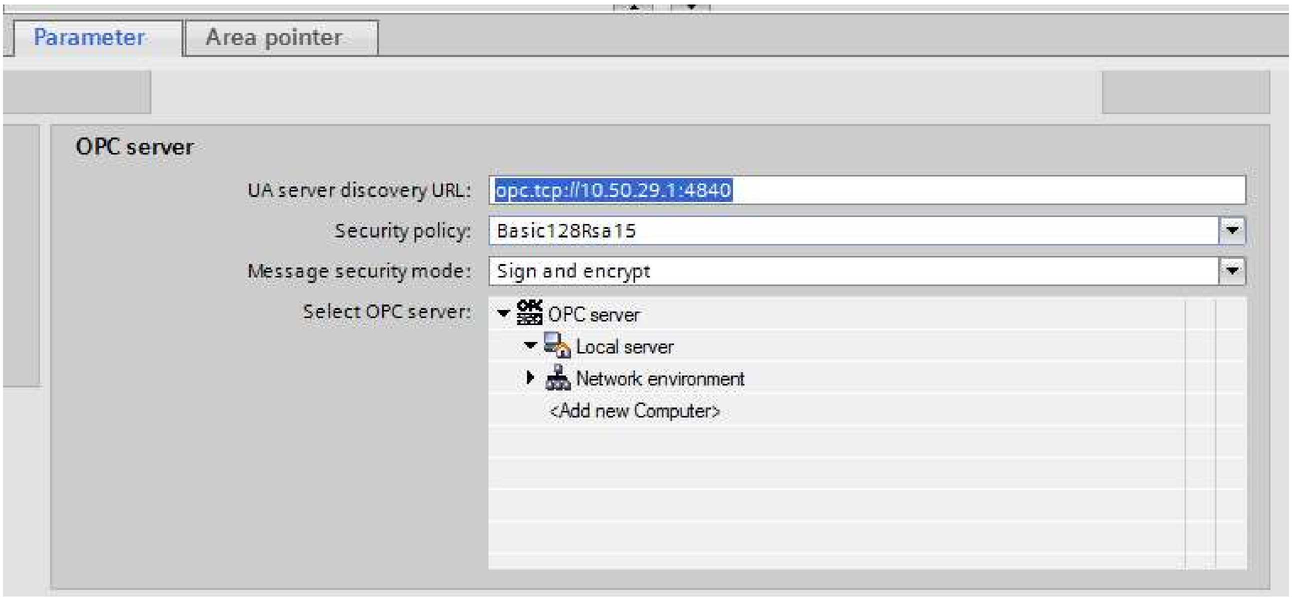


Select "Add new" and add a new connection. Select "OPC UA" as the communication driver.



Name	Communication driver	HM
iQunet_X	OPC UA	
<Add new>		

Fill out the UA Server discovery URL and the security settings.
url = opc.tcp:// 10.50.29.1:4840
policy = Basic128Rsa15
mode = Sign & encrypt



OPC server

UA server discovery URL: opc.tcp://10.50.29.1:4840

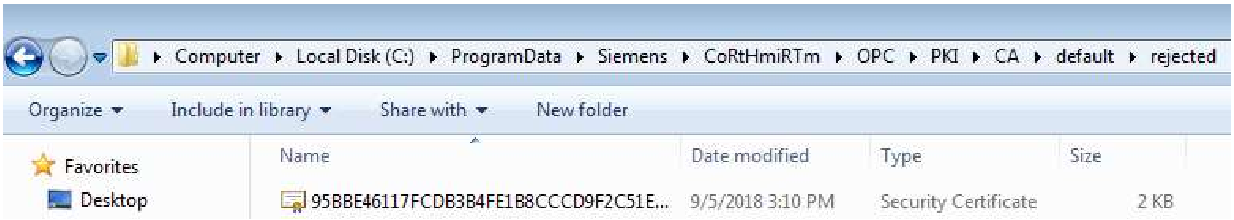
Security policy: Basic128Rsa15

Message security mode: Sign and encrypt

Select OPC server:

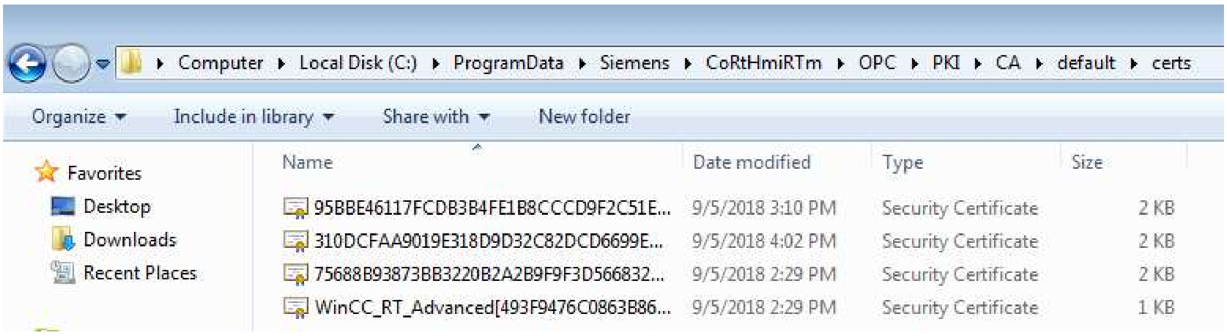
Accept the server certificates. Move the iQunet Server certificate from the 'rejected' folder to the 'certs' folder. The procedure is explained in the following link: https://support.industry.siemens.com/cs/attachments/63481236/63481236_Part5_RT_Advanced_Server_und_Panel_Client_en.pdf.

Move the certificate from C:\ProgramData\Siemens\CoRtHmiRTm\OPC\PKI\CA\default\rejected


Computer ▸ Local Disk (C:) ▸ ProgramData ▸ Siemens ▸ CoRtHmiRTm ▸ OPC ▸ PKI ▸ CA ▸ default ▸ rejected
Organize
Include in library
Share with
New folder
Favorites
Desktop

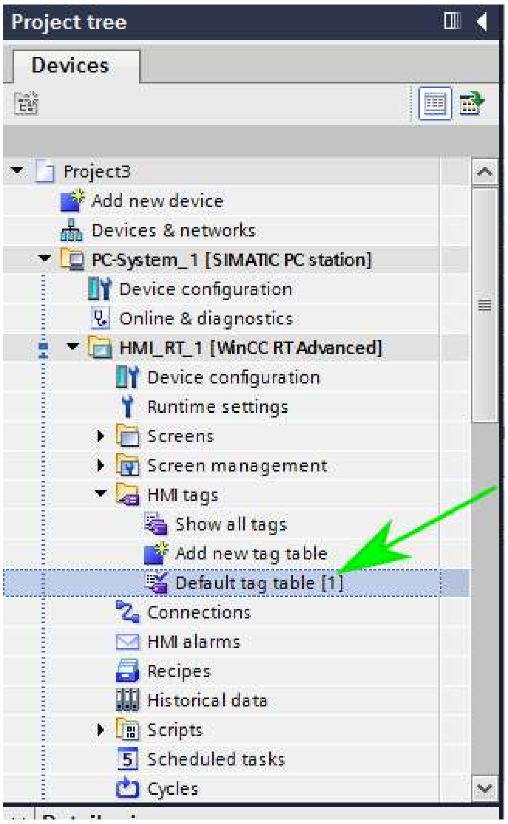
Name	Date modified	Type	Size
95BBE46117FCDB3B4FE1B8CCCD9F2C51E...	9/5/2018 3:10 PM	Security Certificate	2 KB

to C:\ProgramData\Siemens\CoRtHmiRTm\OPC\PKI\CA\default\certs.

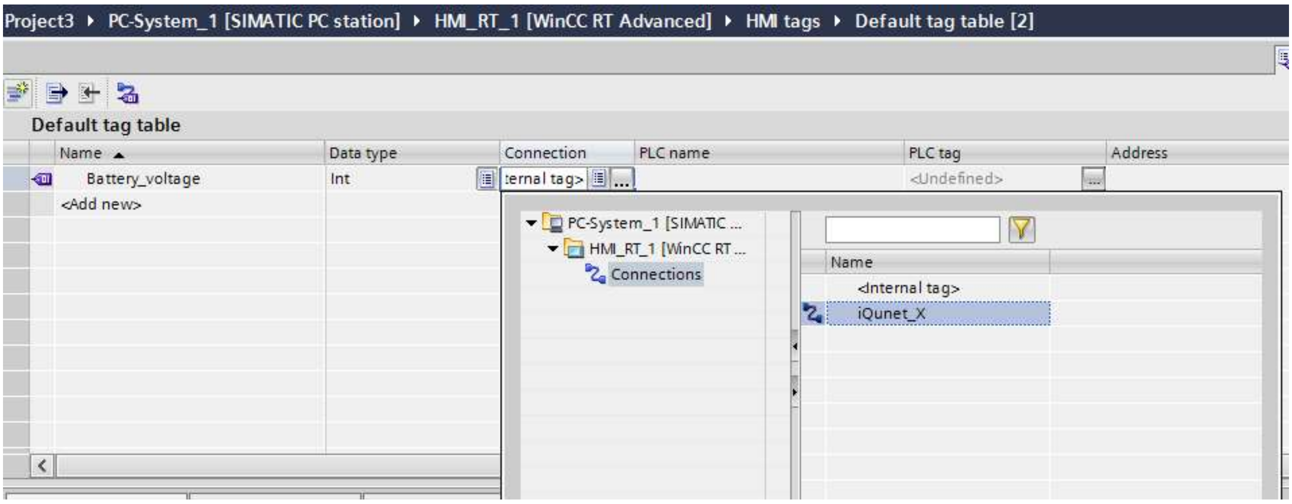

Computer ▸ Local Disk (C:) ▸ ProgramData ▸ Siemens ▸ CoRtHmiRTm ▸ OPC ▸ PKI ▸ CA ▸ default ▸ certs
Organize
Include in library
Share with
New folder
Favorites
Desktop
Downloads
Recent Places

Name	Date modified	Type	Size
95BBE46117FCDB3B4FE1B8CCCD9F2C51E...	9/5/2018 3:10 PM	Security Certificate	2 KB
310DCFAA9019E318D9D32C82DCD6699E...	9/5/2018 4:02 PM	Security Certificate	2 KB
75688B93873BB3220B2A2B9F9F3D566832...	9/5/2018 2:29 PM	Security Certificate	2 KB
WinCC_RT_Advanced[493F9476C0863B86...	9/5/2018 2:29 PM	Security Certificate	1 KB

Set-up the HMI tags. Select “Default tag table [1]” under HMI tags.



Add a new tag → Connection iQunet_X (as set above).

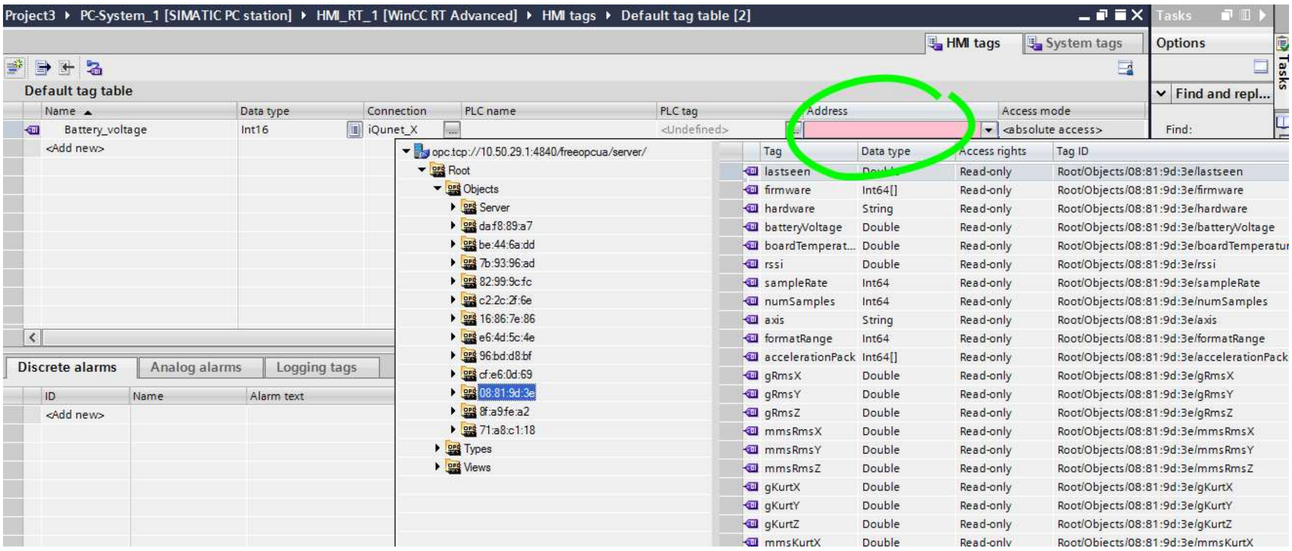

Project3 ▸ PC-System_1 [SIMATIC PC station] ▸ HMI_RT_1 [WinCC RT Advanced] ▸ HMI tags ▸ Default tag table [2]

Default tag table

Name	Data type	Connection	PLC name	PLC tag	Address
Battery_voltage	Int	:ernal tag>		<Undefined>	
<Add new>					

USER MANUAL

Choose the Address. Browse to the Objects node and select the sensor’s macId.



Project3 ▸ PC-System_1 [SIMATIC PC station] ▸ HMI_RT_1 [WinCC RT Advanced] ▸ HMI tags ▸ Default tag table [2]

Default tag table

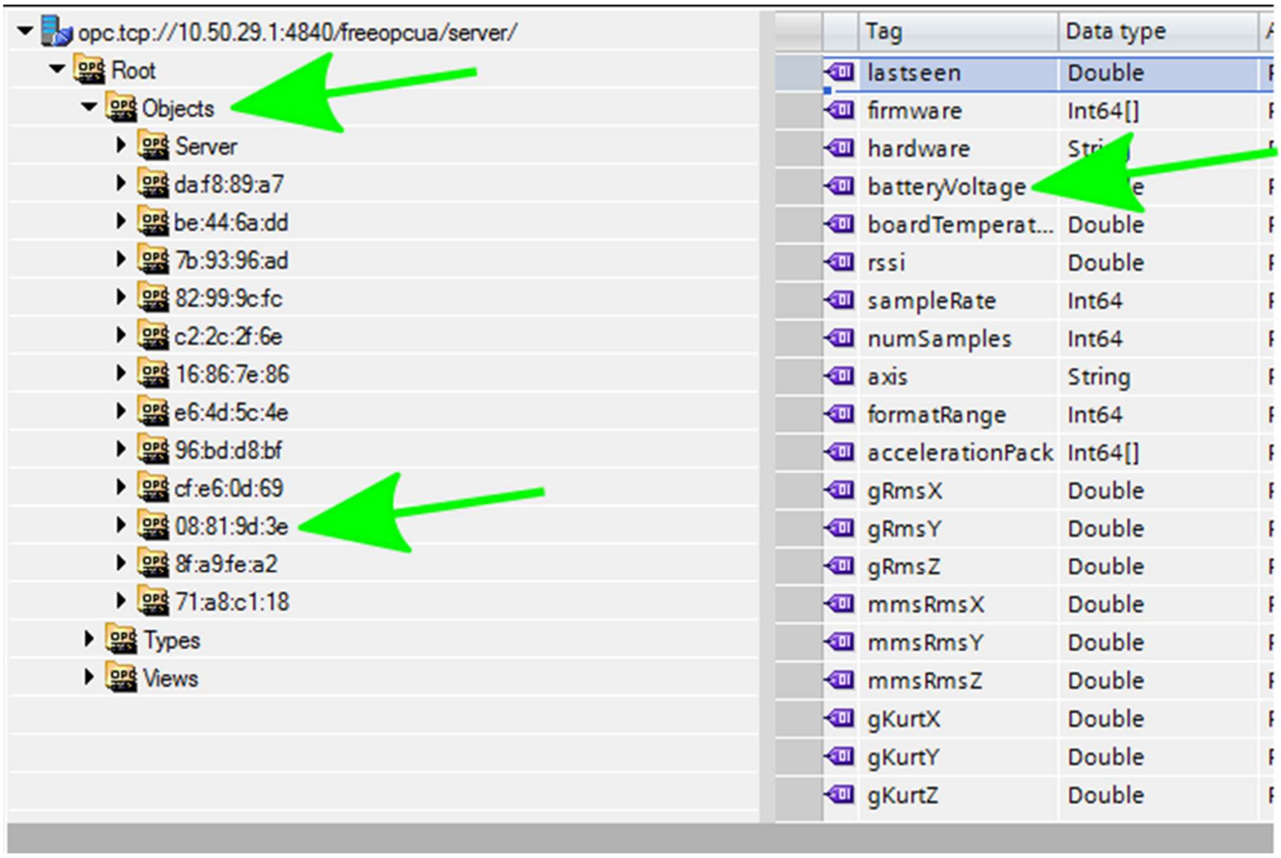
Name	Data type	Connection	PLC name	PLC tag	Address	Access mode
Battery_voltage	Int16	iQunet_X		<Undefined>		<absolute access>
<Add new>						

```
▾ opc.tcp://10.50.29.1:4840/freeopcua/server/
  ▾ Root
    ▾ Objects
      ▸ Server
      ▸ da:f8:89:a7
      ▸ be:44:6a:dd
      ▸ 7b:93:96:ad
      ▸ 82:99:9c:fc
      ▸ c2:2c:2f:6e
      ▸ 16:86:7e:86
      ▸ e6:4d:5c:4e
      ▸ 96:bd:d8:bf
      ▸ cf:e6:0d:69
      ▸ 08:81:9d:3e
      ▸ 8f:a9:fe:a2
      ▸ 71:a8:c1:18
    ▸ Types
    ▸ Views
```

Tag	Data type	Access rights	Tag ID
lastseen	Double	Read-only	Root/Objects/08:81:9d:3e/lastseen
firmware	Int64[]	Read-only	Root/Objects/08:81:9d:3e/firmware
hardware	String	Read-only	Root/Objects/08:81:9d:3e/hardware
batteryVoltage	Double	Read-only	Root/Objects/08:81:9d:3e/batteryVoltage
boardTemperat...	Double	Read-only	Root/Objects/08:81:9d:3e/boardTemperatur
rssi	Double	Read-only	Root/Objects/08:81:9d:3e/rssi
sampleRate	Int64	Read-only	Root/Objects/08:81:9d:3e/sampleRate
numSamples	Int64	Read-only	Root/Objects/08:81:9d:3e/numSamples
axis	String	Read-only	Root/Objects/08:81:9d:3e/axis
formatRange	Int64	Read-only	Root/Objects/08:81:9d:3e/formatRange
accelerationPack	Int64[]	Read-only	Root/Objects/08:81:9d:3e/accelerationPack
gRmsX	Double	Read-only	Root/Objects/08:81:9d:3e/gRmsX
gRmsY	Double	Read-only	Root/Objects/08:81:9d:3e/gRmsY
gRmsZ	Double	Read-only	Root/Objects/08:81:9d:3e/gRmsZ
mmsRmsX	Double	Read-only	Root/Objects/08:81:9d:3e/mmsRmsX
mmsRmsY	Double	Read-only	Root/Objects/08:81:9d:3e/mmsRmsY
mmsRmsZ	Double	Read-only	Root/Objects/08:81:9d:3e/mmsRmsZ
gKurtX	Double	Read-only	Root/Objects/08:81:9d:3e/gKurtX
gKurtY	Double	Read-only	Root/Objects/08:81:9d:3e/gKurtY
gKurtZ	Double	Read-only	Root/Objects/08:81:9d:3e/gKurtZ
mmsKurtX	Double	Read-only	Root/Objects/08:81:9d:3e/mmsKurtX

ID	Name	Alarm text
<Add new>		

Select the sensor attribute or tag you want to observe.

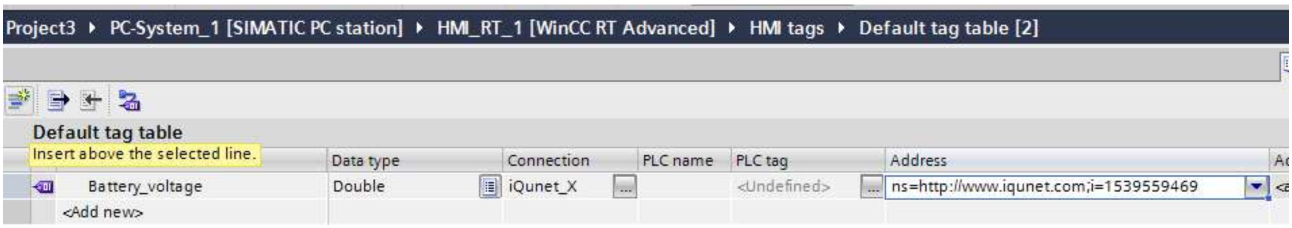


```
▾ opc.tcp://10.50.29.1:4840/freeopcua/server/
  ▾ Root
    ▾ Objects
      ▸ Server
      ▸ da:f8:89:a7
      ▸ be:44:6a:dd
      ▸ 7b:93:96:ad
      ▸ 82:99:9c:fc
      ▸ c2:2c:2f:6e
      ▸ 16:86:7e:86
      ▸ e6:4d:5c:4e
      ▸ 96:bd:d8:bf
      ▸ cf:e6:0d:69
      ▸ 08:81:9d:3e
      ▸ 8f:a9:fe:a2
      ▸ 71:a8:c1:18
    ▸ Types
    ▸ Views
```

Tag	Data type
lastseen	Double
firmware	Int64[]
hardware	String
batteryVoltage	Double
boardTemperat...	Double
rssi	Double
sampleRate	Int64
numSamples	Int64
axis	String
formatRange	Int64
accelerationPack	Int64[]
gRmsX	Double
gRmsY	Double
gRmsZ	Double
mmsRmsX	Double
mmsRmsY	Double
mmsRmsZ	Double
gKurtX	Double
gKurtY	Double
gKurtZ	Double

Subject to reasonable modifications due to technical advances

USER MANUAL



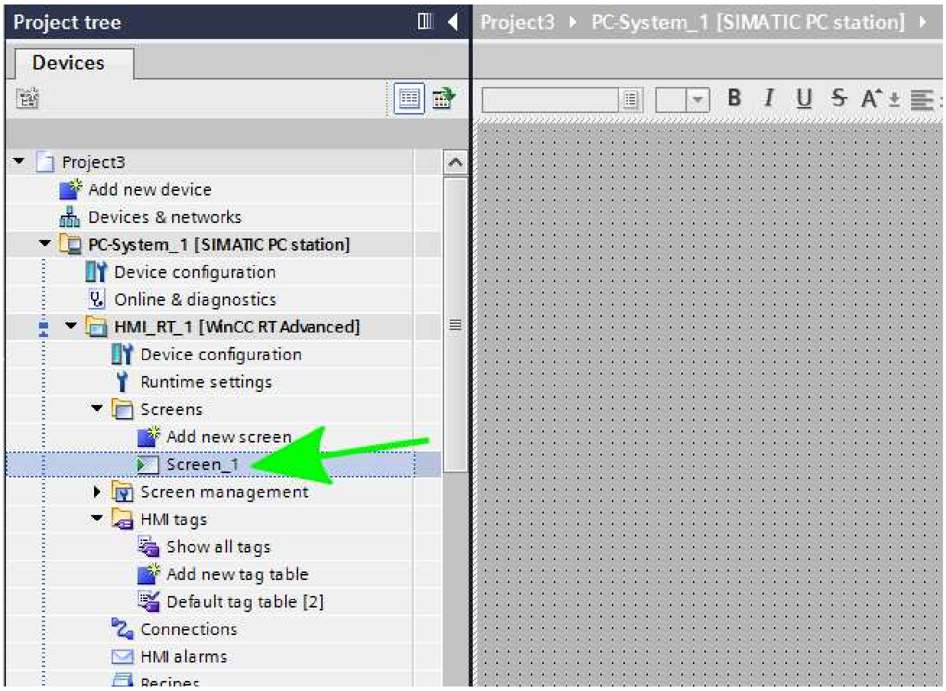
Project3 ▸ PC-System_1 [SIMATIC PC station] ▸ HMI_RT_1 [WinCC RT Advanced] ▸ HMI tags ▸ Default tag table [2]

Default tag table

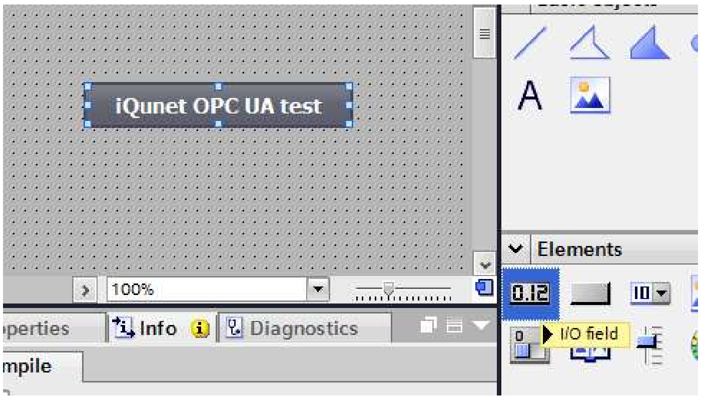
Insert above the selected line.

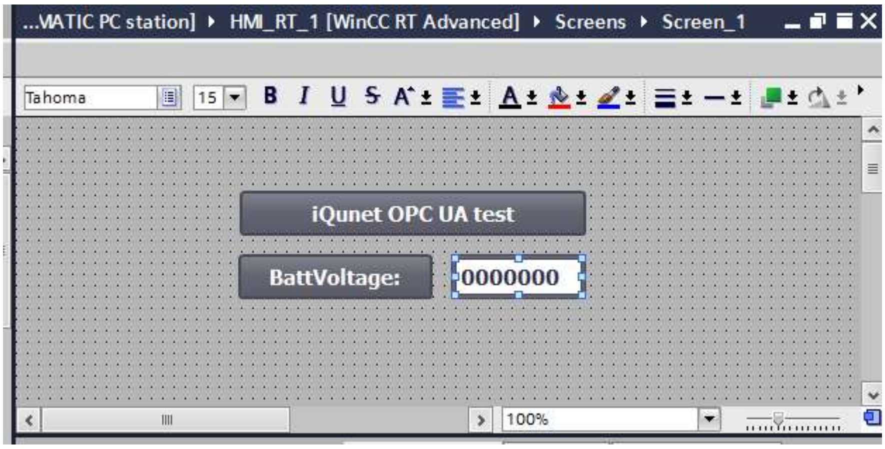
	Data type	Connection	PLC name	PLC tag	Address	Ac
Battery_voltage	Double	iQunet_X		<Undefined>	ns=http://www.iqunet.com;i=1539559469	<a
<Add new>						

Add a new screen using the Screens node.

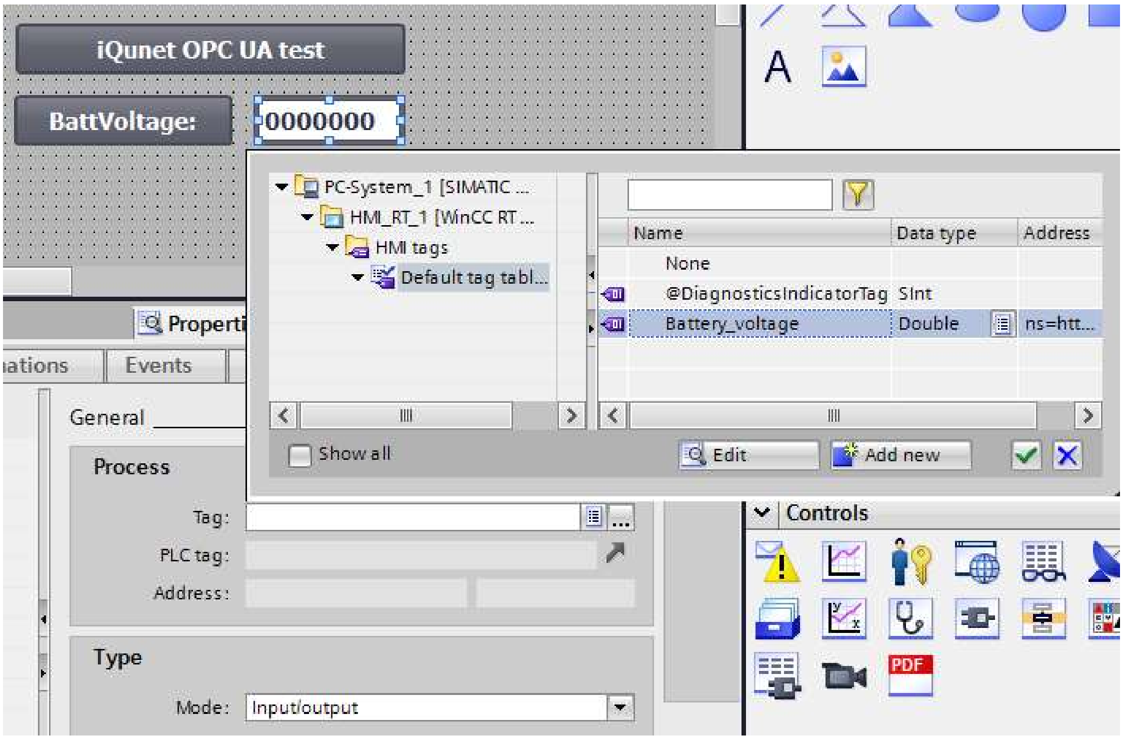


Add a new I/O widget from the Elements group box to the layout pane.




...MATIC PC station] ▸ HMI_RT_1 [WinCC RT Advanced] ▸ Screens ▸ Screen_1
Tahoma
15
iQunet OPC UA test
BattVoltage:
0000000
100%

Select the HMI tag.



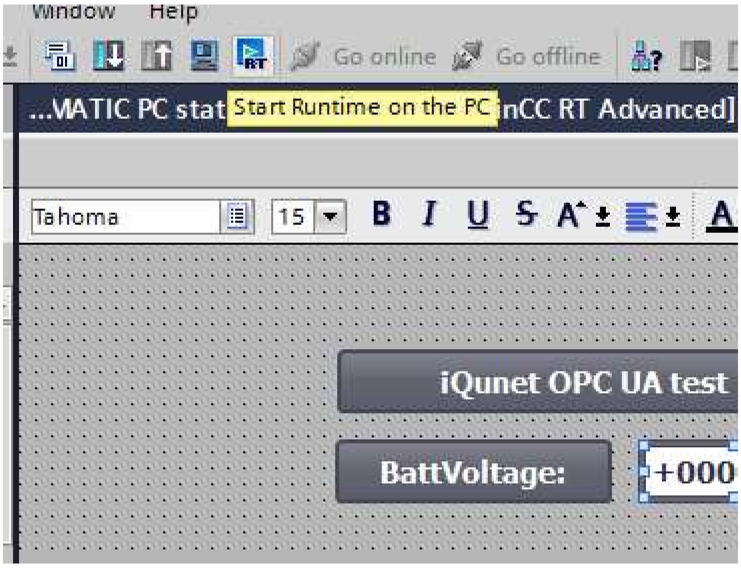
Name	Data type	Address
None		
@DiagnosticsIndicatorTag	SInt	
Battery_voltage	Double	ns=htt...

Tag:
PLC tag:
Address:

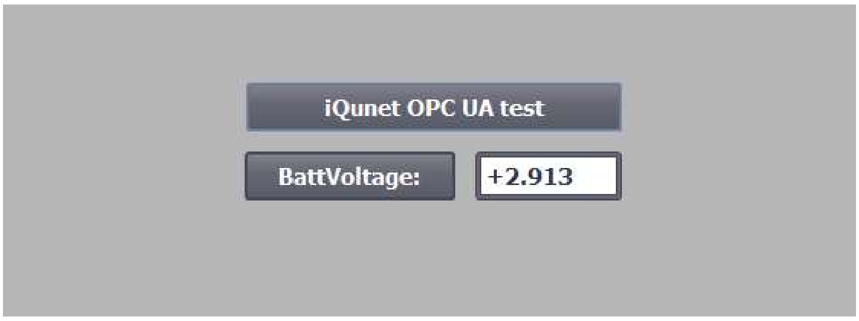
Type

Mode: Input/output

Compile and run.



Check if the OPC UA connection works.



Remark: please note that there is a certificate bug in older TIA WinCC Advanced Version V15 versions (and OPC Scout). You need service pack 1 for this to be fixed in TIA WinCC.

6 Python/Matlab

For OPC UA communication in Python the OPCUA-Asyncio library can be used (https://github.com/FreeOpcUa/opcua-asyncio). You can find 3 example Python scripts on our Github page (https://github.com/iqunet/sern).

Matlab also offers an extension or toolbox to read data directly from OPC UA (https://nl.mathworks.com/products/opc.html).

This website contains a list of the available OPC UA SDKs and toolkits: https://www.opcconnect.com/uakit.php.